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ABSTRACT

Reference material is provided in this book for editors, producers, camera and sound technicians, others working in film, and film students. Each chapter is a self-contained unit about specific aspects of film-making, designed to accompany film courses being offered by the University of the West Indies, the Jamaica Broadcasting Corporation, and the Institute of Mass Communication, in conjunction with Friedrich-Ebert-Stiftung. The following topics are addressed: (1) the Jamaican film; (2) perception; (3) organization and setting up: location or studio, personnel, finance; (4) scripts: development of the idea, treatments, screenplays, shooting scripts; (5) light; (6) filmstock; (7) cameras; (8) lenses; (9) filters; (10) use of lights; (11) the exposure meter; (12) camera work: camera angles, camera movement, the hand held camera, composition, eye scan; (13) continuity of time, place, and action; (14) the laboratory: forced development, answer prints, optical printers, prints, and printing masters; (15) sound: functions of sound; (16) sound recording: nature of sound, magnetic recording, synchronous sound recording, types of sound; (17) editing: sound editing problems; and (18) editing procedure: sound editing. (LMM)

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communication manual

Film Handbook

Jamaica Broadcasting Corporation Film Unit (JBC); Institute of Mass Communication, University of the West Indies; Friedrich-Ebert-Stiftung

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FRIEDRICH-EBERT-STIFTUNG

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FOREWORD

The first edition of this handbook was compiled and published in Jamaica, 1979, with the support of the Friedrich-Ebert-Stiftung (FES) and as one of the instruction media developed by local and expatriate staff of the FES training project at the University of the West Indies.

Since then, the manual was not only used in Jamaica and in the Caribbean area but also made available to partners and trainees of the FES in other parts of the Third World. It became an important teaching and training aid for many workshops and training programmes also in Africa and Asia and is highly esteemed by many of our partners in developing countries. Up to now it is the only filmhandbook compiled and published in a Third World country and distributed worldwide. For example, it is used in a long-term training scheme organized by FES and its partners in Asia where among other Asian trainees young Chinese film experts learnt from their colleagues in Jamaica by way of using the instructions given in this manual.

In the meantime the first edition is out of stock while requests for the book continue to reach us from many parts of the Third World. So we decided to publish a reprint.

Whilst the first edition was rather heavy and uncomfortable to use we changed from the ring-book to an A 5 format paperback, whereas the contents remain unchanged.

We are sure that the second edition will be received by all users - trainers and trainees - in the same favourable way as the first edition.

Reinhard Keune　　　　Gunter Lehrke

Communication Department

August 1983

ACKNOWLEDGEMENTS

The following books were used to compile this Handbook:

Callaghan, Barry:	"The Thames and Hudson Manual of Filmmaking" London 1975
Giannetti, Louis D.:	"Understanding Movies" Englewood Cliffs, New Jersey 1976
Johnson, Lincoln F.:	"Film", New York 1974
Lipton, Lenny:	"Independent Filmmaking", San Francisco 1973
de Mare, Eric:	"Colour Photography", London 1974
Mascelli, Joseph:	"The Five C's of Cenematography", Hollywood 1973
Monaco, James:	"How to Read a Film", New York 1977
Reisz, Karel:	"The Technique of Film Editing" London / New York 1964

Also used were several papers of the German Film and Television Academy, Berlin.

The books listed were used for the following chapters:

Perception (Monaco)
Organizational and Setting up (Callaghan)
The Script (Callaghan)
Light (de Mare)
Filmstock (Callaghan, Lipton)
Camera (Callaghan, Lipton, Monaco)
The Lens and its Functions (Lipton, Monaco)
Filters (Callaghan, Lipton)
Lighting and Lighting Styles (Callaghan, Lipton)
The Exposuremeter (Callaghan, Lipton)
Camera Work (Mascelli, Monaco)
Continuity (Mascelli)
The Laboratory (Lipton)
Sound (Johnson)
Sound Recording (Callaghan, Lipton)
Editing (Mascelli, Reisz)
Editing Procedure (Callaghan, Lipton)

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THE JAMAICAN FILM

It is a difficult task to try and comment on the stage at which film as an art or as an industry stands today. The present economic crisis stands as a barrier at a time when activity is dreamed of, hoped for and lots of plans are being made. There is the limited foreign exchange for raw materials, equipment and services, which are bound to have an effect on the future.

Film makers in the state media, along with those in the commercial sector, are probably too involved to be truly objective on the matter; however, a few historical points and some personalities stand out.

In Jamaica, as in other countries,, the last couple of generations grew up in an age where the still photographer was forerunner to a steady diet of Hollywood and the international film, from the short silent features to talkies, right through to the most sophisticated offerings in colour, that the present technology can deliver.

The film to Jamaican audiences has traditionally been something distant, yet exciting. To the man in the street, the movies, the mobile cinema, the portable projector and even the more recent television, has projected an image, strange, yet familiar, of far-off places, exotic peoples of life-styles that one might hope for but not often has it reflected an image of ourselves.

The Jamaican films that have been made have, nevertheless, had tremendous impact. A new generation may not perhaps realize the fascination with which their parents looked at the first Jamaican newsreel, the first offerings of the government mobile cinema, the first Jamaican cinema commercials, the first television newsreels, commercials, documentaries, or the first Jamaican feature film.

The Jamaican film has been ephemeral as the very stuff of which it is made. The first hesitant steps grow stronger, move forward, step back, grow, contract. The film-maker try, succeed, dream and fall, and some of their films are remembered, but all too often both are forgotten.

D.K. CORINALDI moved from still photography to pioneer experiments in the use of 35 mm movie film - the exposed footage was first developed in small containers or bath tubs and first work prints were produced on an old projector. News features, commercials, attempts at instructional films and documentaries were to follow, as well as a trend to rely on overseas processing facilities.

MARTIN RENNALS who along with Trevor Welsh and Martin Weller were to attend the C.O.I. film course at Mona, became the nucleus of the Jamaican Film Unit. The first modern efforts at Government Public Relations, news film and documentaries, recording our modern history were to have a tremendous effect on this society.

CAREY ROBINSON whose dogged persistence in dramatising our heritage was to create probably one of the most lasting and oft-repeated bodies of work.

Since its opening in 1963, J.B.C. Television was to provide a shot in the arm for the industry with a more regular demand for T.V. commercials.

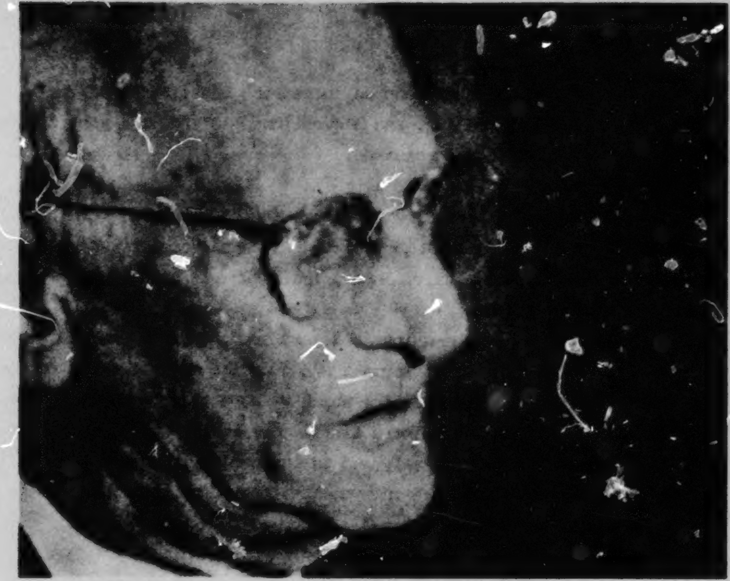
PERRY HENZELLS' Vista Productions which had been one of the pioneers in the film production led the field. As business prospered, more and more one-man production houses to make commercials came on the scene. In the wake of this, Perry Henzells was to realise a lifetime dream; a full length movie feature "The Harder They Come" became a reality, a few more one-shot ventures followed his lead. The J.B.C. Public Affairs Department led by Gloria Lannaman pointed the way to more artistic and investigative film presentation on television.

From the very early days till now, a host of cameramen, producers and technicians have put in their three-pence worth to push the quantity, quality and profitability of films made in Jamaica that much further: improvements in technique, in quality, striving all the time for higher standards and increased productions.

More recently, there has been an increasing questioning of the kinds of films we should be making, and a questioning of how the institutions that produce them should be organised.

The standard yardsticks used have been the body of film work produced in countries all over; the legacy of that international art of the 20th century from Hollywood, Italy, Japan, India, Russia to Sweden or whereever.

Techniques that have been invented, explored, copied, adapted, changed, repeated by hundreds of film-makers and crafts-men, form a storehouse of constantly changing inspiration which we hope this handbook and series of courses will help to make a little more familiar; as we attempt to make film images speak effectively and in our own particular way about the problems, the people, the achievements, the ideas and the many things which we create.



D.K. CORINALDI

A frame from one of Corinaldi's early films

Members of the first film course. Front row: 1. from right Martin Weller, Back row: 3. from right Martin Rennals, 4. from right Trevor Welsh

CAREY ROBINSON

PERRY HENZELL

INTRODUCTION

The purpose of this handbook is to provide reference material for producers, editors, camera and soundmen, as well as all people working in film, or taking part in film courses organized by the IMC, JBC and the Extra-Mural Department of the U.W.I.

In the Jamaican situation, without the specialized approach of a more highly organized and structured industry, most film-makers have had to develop a sort of multi-taltented approach, where to get the production done at all, they must produce, write, direct, and in some special cases, shoot, edit and serve as production managers.

While specialization might be considered desirable and more productive, it is of the utmost importance that anyone working in film (whatever their function might be), have a thorough knowledge of all aspects of film technique if their films are to have high artistique and technical quality.

The material for this handbook has been collected and compiled from various sources and is only intended for the internal use of these organizations and their individual employees.

The material has purposely been arranged in file form so that additions can be made in future. Each chapter is a self-contained unit and provides information on specific aspects of film-making.

This handbook has been specially designed to accompany the film courses being offered in collaboration with the FES, the UWI and the JBC.

PERCEPTION

Film is an art which appeals to two of the five human senses: seeing and hearing. It does this through highly technical means. Therefore, first of all the film-maker's work is limited by the ability of perception of his audience and by the technical means at his disposal.

Perception has two sides: the receptor organs, eyes and ears, and the brain which does something with the information received. There is a difference between these two receptor organs which has to do with their particular functioning. Provided the brain is functioning, ears hear whatever is available for them to hear, but eyes choose what to see. They choose not only consciously (to direct attention to this line or to go over to the next one, or to ignore sight altogether by closing the eyes) but unconsciously as well.

The receptor organs which permit visual acuity are concentrated only in the fovea of the retina. Therefore, it is necessary for us to stare directly at an object in order to have a clear image of it. Since most objects we look at are larger than, for example, a point, the eyes must move constantly from one point to another to encompass the whole object. These semi-conscious movements are called saccades. Each saccade takes approximately 1/20 seconds. While the eyes move from one point of the object to the next one, the first impression is retained for about the time a saccade takes in order not to forget it. This retaining, this keeping of one impression on the retina for a short interval is called "persistence of vision". It is just this physical phenomenon that makes film possible.

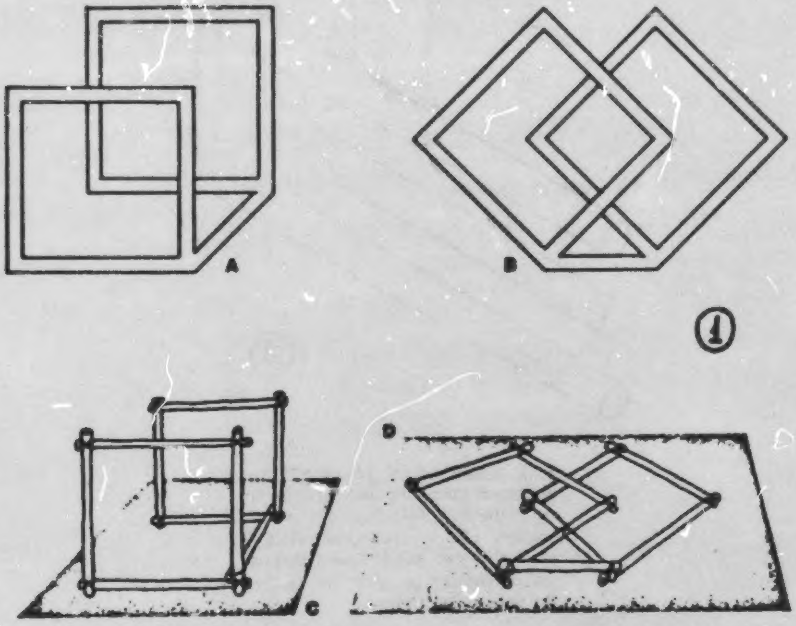
The fact that man possesses foveated vision leads to one conclusion: vision and perception of any object needs time. This time is not inherent in the object as such, but set by the observer. He explores an object to see it properly. He chooses what to look at and in what order of succession by directing his vision consciously and unconsciously. It follows that the more extensive and quick a person's saccadic patterns are, the better and more efficiently he will see. If someone is more used to look at things, if his visual perception is better trained, he will see more in a given amount of time.

To see and comprehend the reality which surrounds us needs education for our eyes. But it obviously needs more training for our visual sense to perceive and our brain to understand recorded images. This is not so to the same extent, of our auditory senses. The education our ears need in order to perceive reality is usually sufficient to perceive recorded sound. Or, to put it in another way, if the machinery is sophisticated enough, our ears can hear no difference between real and recorded sound. One of the main reasons for this difference is that images, whether paintings, photographs or film-pictures present objects which normally have three dimensions, namely: width, height and depth in a two dimensional frame.

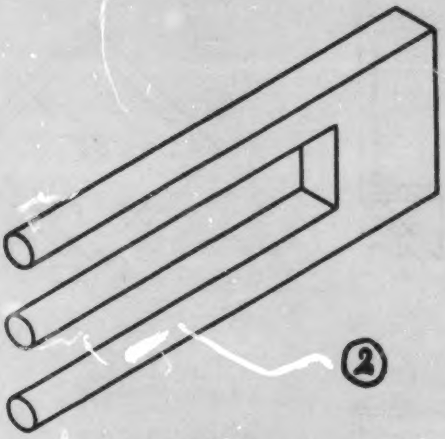
To recognize the depicted three dimensional reality in a two dimensional picture which has only width and height, needs training. Moreover, it is not only an ability which has to be learned, but it is also one which differs from culture to culture. Since not all cultures try to record in a two dimensional frame and, if they attempt to do so, they do not necessarily do it in the way we do. Because of this, there are cultural differences in the perception of images. In the 1920s, the anthropologist William Hudson tested rural Africans who had little contact with the Western culture, to discover if they perceived depth in two dimensional images the same way Europeans do. He found unequivocally that they did not.

Therefore, though every normal human being can perceive and identify a visual image, what the brain does with the information received through the eyes, depends largely on learned patterns of interpretation which are different in different cultures.

People trained and educated in Western culture have not only learned to perceive two dimensional images as depicting three dimensional reality, but they also tend to read depth into all two dimensional design. Training has formed expectation and habit.



CONSTRUCTION-TASK FIGURES. Subjects asked to reconstruct these figures in three dimensions, using sticks or rods, respond in different ways. People from Western Cultures, trained in the codes and conventions that artists use to convey three-dimensionality in a two dimensional drawing, see A as three-dimensional and B as two-dimensional. The operating code for three-dimensionality here insists that the dimension of depth be portrayed along the 45° oblique line. This works well enough in A, but not in B, where the oblique lines are not in the depth plane. Subjects from African cultures tend to see both figures as two-dimensional, since they are not familiar with this Western three-dimensional code. Figures C and D illustrate the models of A constructed by Western and African observers, respectively. *(From "Pictorial Perception and Culture," Jan B. Deregowski. 1972 by Scientific American, Inc. All rights reserved.)*



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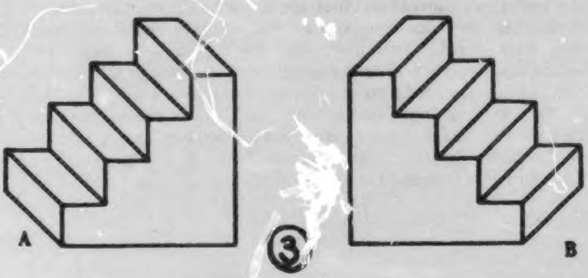
THE AMBIGUOUS TRIDENT. The illusion is intriguing only because we are trained in Western codes of perspective. The psychological effect is powerful: our minds insist that we see the object in space rather than the drawing on a plane.



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THE UPSTAIRS/DOWNSTAIRS ILLUSION.

Since Westerners tend to read from left to right, we see stair a ascending and stair b descending.

In Fig. 1, four conventions of depth perception are depicted to show how we have learned to read depth into a two dimensional frame. There are also conventions of another sort we have acquired through learning.

We tend to give the bottom of the frame more importance than the top, therefore objects placed near the bottom have a stable quality, the ones more at the top are, in tendency, perceived as unstable. Horizontals will also be given more weight than verticals; confronted with horizontal and vertical lines of equal length we tend to read the horizontal as longer. Part of these interpretation patterns derive from conventions formed in the history of the visual arts. Parts have their origins in cultural habits. Since, for example, the written word in our culture goes from left to right, not, as for example, in arabic from right to left or, as in other cultures, both ways, we also tend to read pictures in this direction. Because, for us, left comes before right, we perceive diagonals from bottom left to top right as going "up" from stability to instability. Therefore stairway a. in Fig. 3 seems to ascend and stairway b. to descend despite the fact that stairways always go both, up and down.

Part of the meaning we tend to attach to specific forms rely on physical experience. A triangle which rests on a broad base like a pyramid, tends to convey strength and stability because we know that something with a solid base can neither fall down nor be moved easily.

From this we can conclude that the mental perception of pictures also has a psychological side. Not only have we learned to read depth into a two dimensional figure, but we also tend to attach a special quality to the depicted objects according to their placement in the two dimensional frame. To better understand the way in which mental and psychological perception function in film, it is necessary to regard film as a system of communication. Like all systems of communication film funtions very much like a language. However, film is not a proper language. Film has neither vocabulary nor grammer, but it has developed a system of signs, codes and a sort of syntax.

Furthermore, it is necessary to distinguish between the two visual aspects of film: the single image or shot and the succession of these images or sequence of shots.

A film image can be compared to a sign in language. A sign consists of two parts: the signifier and the signified. The word "rose", for example, the collection of letters and soundsis the signifier, which stands for something else, the signified. If several people read the word "rose" it is likely that each of them imagines a different one. In cinema, all viewers see the rose and they all see the same one. A picture of a rose is much closer to the thing than the letters or sounds of the word are. In film, therefore, the signifier and the signified are almost identical. With its signs, film does not "suggest", it states.

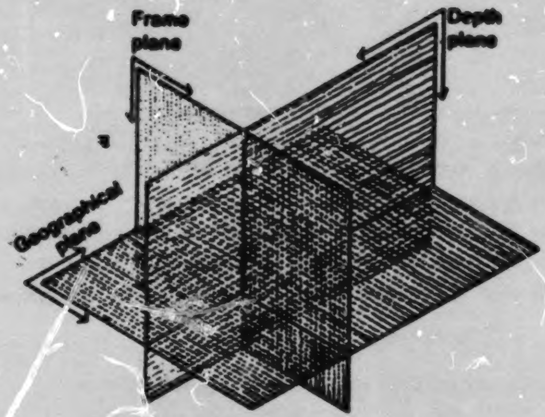
Through this close approximation of reality, film can communicate precise knowledge about physical realities. Written or spoken language may be better equipped to deal with the non-concrete world of ideas and abstractions. Film, however, is definitely more precise when it comes to depict physical reality.

With the picture of a rose, the film-maker chooses a rose out of an infinite variety of roses, but he also chooses how the rose should be looked at, by choosing one out of an infinite variety of ways to photograph it.

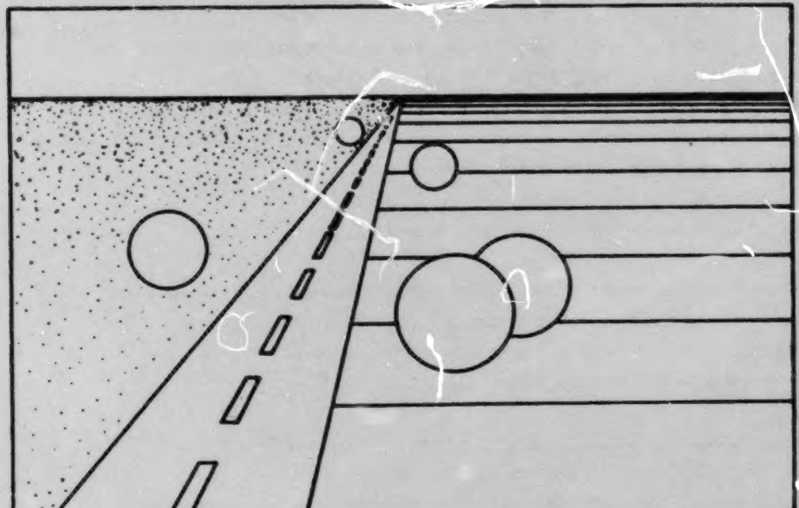
The rose is filmed from a certain angle, the camera moves or does not move, the colours are bright or dull, the thorns are apparent or hidden, the background is clear, so that the rose is seen in context, or vague, so that it is seen isolated, the shot is held over for a long time or only shortly, and so on.

Since as we have seen, mental and psychological perception of a picture is influenced by the way the object is depicted, this decision of the film-maker gives a special meaning to the rose shown.

The other way in which a picture in a film acquires a meaning is through the comparison of one shot with the shots which precede or follow it.


Frame plane
Depth plane
Geographical plane

THE THREE PLANES OF COMPOSITION.



CONVENTIONS OF DEPTH PERCEPTION. Four major conventions of depth perception are illustrated here: convergence (the boundaries of the road), relative size (the near and far balls), density gradient (of dots on the left, of lines on the right), and overlapping (the balls on the right).

BEST COPY AVAILABLE

One shot contains as much information for us, as we are able to read it. according to our saccadic patterns. But the mental and psychological perception of this shot is already conditioned by the shot or shots which precede it and it will be influenced further by the onescoming after it. Unlike paintings or photographs, film has its own dimension of time. Film is composed through a continuum of meaning. Each shot gets its significance not only by itself but also through the context in which it is shown.

In its history, the medium film has developed special conventions in regard to these two visual aspects. Part of these conventions film has borrowed from the other visual arts, and some have already been mentioned. Part of them are inventions of film itself, especially those which concern the succession of images, a sort of syntax of film. The observer who is used to seeing movies has learned how to connect the successive images so that a continuum of meaning develops. He knows, for example, that a picture of only a face filling the whole screen, is not the head of a giant, so big that only his face can be shown on the screen, but that this picture simply shows a magnified view of a normal human face. He interprets the close-up the way it is meant, because he connects this shot with the preceding and following shots.

The advent of film has changed our perception.

This even holds true for the simple physical level. People today tend to see quicker, their saccadic patterns have become more efficient. Therefore, also, films today are quicker, shots change after a short time, the rhythm of editing has become faster.

The audience has adapted his perception at all levels - physical, mental and psychological - to the medium. The movie-goers have learned to read the codes of film, they have developed an understanding concerning their meaning.

THE INFLUENCE OF TECHNIQUE

The other aspect of film is its technique. All arts have a technical, material side. As all arts, film is deeply influenced by the political, social, philosophical and economic factors of society. But since film depends much more heavily on its technical means as many other arts, it has been shaped considerably in its form, styles, codes, syntax and topics by the complex and sophisticated technology it has to use.

It already starts with the picture frame. The frame determines the limit of an image and influences with its relation of width to height, the aspect ratio, the possible composition of each shot.

For instance, interiors and dialogue dominated the screen before the mid-fifties, much more than they do today. After the introduction of the wide screen, exteriors, location shooting and action sequences grew in importance. These subjects could be better depicted in a format which gave not simply a bigger picture, but where the relation between width and height of the frame was such that the picture showed more width. With more to see at the side, movements in each shot became longer, and the panning movement of the camera more impressive. The aspect ratio of the T.V. screen, on the other hand, does not lend itself as readily to similar subjects. In T.V. production not only are long shots often substituted by full shots, but generally the proportion of "nearer" shots is higher because of the limited size and the proportion of the picture frame.

The change in the relation of width to height on the wide screen, for instance, changed the code of the two shot. In the classic two-shot the proportion of the frame tended to focus attention on speaker and listener and to create an atmosphere of intimacy. On the wide screen, however, two people can no longer fill the screen, so that it is almost impossible to photograph them without calling attention to the space surrounding them. The intimacy of the smaller frame is gone, but the wide screen two-shots can tell even more about the people depicted if they are arranged with regard to the space of the setting and if the environment is carefully composed.

Also, the physical nature of the filmstock and all the aspects related to exposure developed styles and codes.

The necessity to use artificial lighting before the 1960s when filmstock was relatively insensitive, limited the film-maker's choice of what to film and how to film to a certain extent. On the other hand, the film makers made a virtue of this necessity and through it created entire styles. Lighting was not only used to provide the necessary intensity of light, but to modify the meaning of forms, lines and colour. So, for example, the lights were positioned in such a way that the image was divided into marked dark and bright parts to emphasize dramatic effects. The classical Hollywood style, on the other hand, tried to balance the light quality of the overall picture with its "key" and "fill" lights. The development of fast filmstocks not only permitted a new latitude in the code of lighting, but also changed styles at least as far as black and white films were concerned, and also multiplied the number of possible subjects. Now it is possible to film relatively dark objects and places even without sophisticated lighting equipment.

Faster filmstock, i.e., filmstock which is more sensitive to light, is by physical nature more grainy than others. Enlargements also tend to be grainy. We have therefore learned to associate graininess with documentary shots where fast filmstocks are preferred to cope with bad light conditions. The simple technical fact of graininess leads to an association which has developed into a code: a grainy image signifies a "truthful" one, because it either gives a closer look or it depicts a real thing.

The advent of colour film has opened up another new dimension. Colour not only allows us to film things more "naturally", it also allows the film-maker to choose the colours of certain objects so as to give them additional meaning. Moreover, the film-maker can, for example, counterbalance the position of an object at the top of the frame by giving it more weight through a bright colour which catches the eyes easily.

It is not necessary to show in detail how the development of lighter cameras have influenced film styles. It is easy to imagine that a camera which can be held in the hand not only makes camera movements more flexible, but also permits filming on difficult location where neither tracts nor dollies can be used.

The perceptive ability of the audience and the technical means at his disposal are aspects that the film-maker has to keep in mind. We have shown both these aspects in relation to their influence on style, codes and conventions. But these conventions are not rules. The main reason for the above outline was to show that they are a result of usage. As with written or spoken language, the language of film evolved as certain devices proved to be useful and workable in practice. The language of film has changed considerably over the years. The conventions of the classical Hollywood style, may today seem laughable in many respects, but during the thirties, forties and early fifties, they were the model according to which Hollywood films were constructed. And, they are only outdated in part. Up to now the classical Hollywood language shapes the way in which not only films but also, and moreso, T.V. series are made. Therefore many of these conventions are still the ones most moviegoers and T.V. watchers are used to. The reason for the impact of Hollywood, is the dominance of American films on the screens all over the world, and especially in countries like Jamaica. Film business in Hollywood was an industry. It was not so much the individual film-maker who created a work of art, but the craftsman, who produced an article for an industry. Moreover, he did not manufacture the whole product from beginning to end, but he worked on the part he was specialized in, i.e. camera, editing, directing and so on. Out of this organisation of work evolved the necessity to standardize. Hence film codes and conventions developed much more easily than elsewhere. On the other hand, the Hollywood craftsmen were, no doubt, skilled people. They knew how to make an entertaining, amusing and successful film. It is not only by chance that, for example, many young European film-makers, whose films are markedly different from the Hollywood products, nevertheless study and admire the skills and craftsmanship of their old Hollywood predecessors.

Since the Hollywood language has formed the medium and the perceptive expectations of the audience all over the world to such an extent, many of the codes and conventions of the chapter dealing with camera work derive from that source.

ORGANIZATION AND SETTING UP

Many stages and elements make up a film and the success of each depends to a greater or lesser extent on the success of all the others. Further, because of the length of time over which the film-making process extends, and because of the unrepeatable nature of much of the work (for reasons of expense, subject availability and time), an ill-prepared or botched job in any one department of the film remains with the film-maker for a long time, and will have a detrimental effect on the finished work. However, good the sound-track, editing and acting of a film may be, the total effect of the film will be poor if the camera work is shoddy. A shot taken on a distant location, marred by poor colour or poor exposure because the cameraman had forgotten to take with him the correct filter, may well be indispensable to the structure of the film, and keep reminding the editor - possibly the same man - of the lack of organization that led to its failure. And what is more, the audience will notice it too.

A carefully prepared script will ensure efficient shooting; carefully logged and labelled picture and sound rushes will help smooth editing; carefully prepared locations and well-chosen equipment will ensure good-quality sound recording; and all preparation will save time.

The setting up of a film falls broadly into two areas - the organization of ideas and the organization of facilities. Organization of facilities can be grouped under four heads: equipment, the location or studio, personnel, finance.

EQUIPMENT

It is essential that all equipment necessary for a shooting session be on hand, and all contingencies should be planned for when organizing equipment, especially for location shooting. An analysis of equipment necessary is the first requirement. Heavy lighting, for instance, will not often be needed for exteriors, whereas a small sun-gun may be useful.

Especially where equipment must be transported, an accurate forecast of needs will pay dividends.

Checklists should be made to ensure that small items that may be overlooked during rushed loading are not forgotten. It is probably as well to have checklists for each group of equipment, e.g., a camera checklist, a lighting checklist, a sound checklist. Checklists will be compiled by each individual film unit according to their equipment, but a camera checklist, for example, may look like this:

Camera
Lenses
Tripod, head and spreader
Shoulder pod
Baby legs
Tripod adapter
Lens hood
Filter holders
Filters
Lens tissues
Lens brush
Batteries and cables
Magazines
Changing bag
Camera report sheets
Viewing filters, colour and b/w
Blower brush
Cores and spools
Masking tape
Felt-tip pen
Carrying cases
Simple tools: screwdrivers, pliers
Filmstock
Spare cans
Blanking caps and lens caps
Exposure meter and accessories
Tissues
String
Clapper-board
Chalk
Tape measure
Waterproof covering material

Lighting and sound checklists should be compiled in similar detail, and all should be checked before the shooting session. Except in very well-equipped film units, it may be occasionally necessary to rent certain items of equipment. In small-unit 16 mm production, renting of equipment can be a significant part of the budget; renting should be carefully considered, and time allocated so as to make fullest use of the equipment during the period of rent.

Consumable material - chiefly filmstock and magnetic recording tape - must be accurately estimated. A good stock of reserve should be allowed to cover unexpected opportunities, retakes, mishapes, technical errors and so forth.

The type of filmstock will probably have been decided at the shooting-script stage; but if possible, tests should also be carried out to ensure that no factors have been overlooked in the original selection of stock. As a simple example of this, the estimated lighting for an indoor location might prove impracticable, and a faster film than at first suggested might prove necessary. A visit to the location before shooting will give the necessary information, but where this is not possible, or in cases of doubt, alternative filmstocks should be taken.

The orgnization of equipment for a film does not stop at the successful arrangement of a shooting session. Before the first foot is shot, ascertain that the facilities to handle the processed footage are to hand. Is a cutting-room available for the estimated time of editing? Is the cutting-room fully equipped to handle all the shot film and sound? If sync footage is to be cut, for example, is there access to a picture synchronizer and an editing-machine or table?

Familiarize yourself with the laboratories and sound studios to be used, as these will play a vital role in the completion of the film. It is necessary to be certain that your labs can handle the type of filmstock being used and that the quality of their work is up to the standards required. Learn their preferred system of marking up and presentation of work; this will help them to give efficient service. The labs chosen should be able to do any kind of duplicating, printing and optical work that may be necessary to the film, and carry out any other services. A clear definition of requirements, and a close liaison with the firm chosen, will ensure that all lab work is carried out smoothly.

Finally, transport must be arranged, not only to deliver equipment and personnel to locations, but also for collection of equipment, delivery of work to labs, and attendance of appropriate members of the editing team at grading conferences, dubbing sessions and so forth.

THE LOCATION OR STUDIO

Organization for studio filming with small-unit 16 mm production should be straightforward.

Any shortcomings in the studio's facilities should be made up when equipment is being arranged though, in addition to the provision of technical equipment, fittings, props and so on must be made available as and when required. For indoor work not in a properly equipped professional studio, organizational problems will be similar to some of those encountered with location filming, with the addition of special considerations such as the provision of materials for props and fittings.

Location filming, where the situation is not directly under the control of the film unit, and where the film-maker must adapt to the circumstances, presents special problems of organization and must be thoroughly prepared if the required amount of work is to be produced in the time available. The best solution is for the film-maker to visit the location in advance of filming, to assess the advantages and drawbacks of the situation, and to adapt his script and shooting schedule to what he finds. If such a visit is impossible, contact should be established with somebody at or near the location who can answer detailed questions about it, and who can act as a liaison officer for the scene. An obvious example is the public relations officer of a firm for which a film is being made.

Location work can include both interior and exterior shooting, and can cover both controlled and uncontrolled action. With controlled action, where the director can stage every shot as he is ready to shoot, and can consider refinements on the shooting script, or alternative ways of shooting a take, the technique may be similar to that of studio production. But the location itself will certainly not be fitted out for filmmaking. You should therefore concentrate on making the best use of such facilities as do exist.

1. The unit will want a room to use as a base, where equipment can be stored and kept clear of the shooting area, which may well be severely limited anyway.

2. For most interior locations, lighting of some kind will be used; the electricity supply must be confirmed. For lighting requiring an excess of 30 amps, an electrician will be essential to wire the lighting supply direct from a mains panel. If a sufficient supply of electricity is not available on the location, modified or altered lighting arrangements will have to be made.

3. The location must be assessed for camera and lighting positions, and for sound-recording possibilities. Is there enough floor space to make use of a camera dolly? Will normal and/or short tripods, or table-mounts, be required for the camera? Lamp stands may clutter up limited space, and pole-cats or existing supports can be utilized.

   Will amber gels or blue filters be needed to even out mixed light sources? If any sound recording other than guide tracks is to be done on the location, the acoustic character of the room should be assessed and, if necessary, improved.

In uncontrolled filming, a thorough assessment of the location is even more important. Where the cameraman must shoot a once-off, unrepeatable action while it is happening; with no chance for retakes - a procession, perhaps, or a sporting event - practical questions such as camera positions, lighting, and suchlike, must be decided beforehand as there will often be no chance of changing them once the shooting has begun. For large-scale outdoor events, envisage the scene as well as possible and make arrangements for the best camera positions in advance. High vantage points, such as the roof of a large building, or positions on a private piece of land must be negotiated for, and the need for extra camera operators - perhaps with a hand-held camera or perhaps with a camera to shoot cutaways - must be considered.

Permits or photographers's passes may be required to shoot in certain locations, and should be obtained in advance; local police regulations about photography in public places should also be mastered. The question of release permits (written permission to use footage including well-known or professional people, for example), may have to be examined. Thoughtful preparation of uncontrolled exterior filming will pay dividends: without it many good shots may well be missed. Unlike controlled location work, the fresh idea that occurs while filming may prove impossible to realize, solely because of organizational difficulties. The spectre of an editor moaning "If only...." often haunts film studios.

Other considerations for location shooting generally include alternative arrangements in case of unsuitable weather (with the complications of location shooting, a day lost through rain may prove expensive in time, and possibly hire of equipment: forethought may make it possible to shoot an alternative scene on what would otherwise have been a wasted day); estimation of time required for the scene (it is too easy to underestimate, and setting up of equipment alone can make large claims on hoped-for-shooting time); and of course the provision of transport and facilities such as food and shelter for the personnel involved.

Especially on a distant location, the emphasis on planning cannot be too heavily stressed. A careless shot at the end of a day, a shot missed because the camera was not in the right place at the right time, a vital part of the operation not covered well enough in the footage shot - all will leave their mark on the finished film. The editor can only work with what the camera crew brings back with them.

PERSONNEL

Every single person involved in any way with the shooting of a scene must be at all times fully aware of what is going on and what is required of him. Filming is too complex and expensive an operation for a whole unit to be held up for two hours because an electrician has not turned up, or because a factory manager has forgotten that this was the day that the scene was to be filmed. It is the film-maker's responsibility to see that all people involved are aware of, and reminded, perhaps on the day prior to shooting, of what is necessary. It is only too easy to set up a scene, say, demonstrating some technical process, only to find that the only man capable of operating a vital piece of ancillary equipment has gone away to a one-day conference, and is unobtainable; or to set up a dramatic scene with five extras of whom (especially if unpaid) three fail to materialize - each assuming there will be four others left, and that they will do. It is also important to ensure that there is an appropriate person available to do any job that may prove necessary. Hoping that 'someone will be around' who has the talents or qualifications needed is unsafe in film-making, and time and goodwill (in itself a not inconsiderable asset in location work) can easily be lost searching around for someone to stand in. The philosophy of "it'll have to do" has no place in film-making.

FINANCE

Nearly every 16 mm film is made to a budget, from a student's first exercise to a full-scale prestige or television production costing tens of thousands of dollars. Since the money available has very far reaching effects on the final nature of the film, the financial organization should be very carefully worked out.

The kind of budget a film gets depends obviously on the type of film, and the purpose for which it is made. The position of the film unit, the number of outside services it has to call on, the extent of overheads and professional fees will all have their effect on the final figure. Whereas the professional film unit's budget will very largely be taken up by such things as overheads, wages, depreciation, etc., the budget of a student film may be almost exclusively devoted to raw materials, and laboratory and sound-studio charges.

The first requirement, then, is to establish what must be paid for from the finance of the film, and to apportion the money available to the best advantage of the film.

Items common to all budgets will be raw materials, laboratory and sound-laboratory charges, and hire fees, if necessary. The following are typical items that might go towards making up the material side of a budget:

Raw materials

The cost of filmstock will vary according to the stock used, especially between black-and-white and colour. The amount of film used will depend not only on the total length of the projected film, but also on the nature of the subject, and the degree of control the director has. With a well-planned technical film, it may be possible to use almost all the footage shot: with uncontrolled filming it may be necessary to shoot five, or even twenty times the final running time of the film. Furthermore, special stocks may be needed for particular purposes: high-contrast stocks for titling, for example.

Remember when estimating amounts of magnetic recording tape required that is not consumed at the same rate as picture film - more or less may be required, according to circumstances.

Black spacing is essential in master assembly (A & B roll), and since it is as costly as filmstock it should not be overlooked in budgeting.

Assorted leader and spacing required at various stages, particularly track-laying.

Sundries - several small items required during editing, e.g. splicing tape, chinagraph markers.

Laboratory charges

Processing. The lab will provide a complete list of all costs, reckoned by the foot. Note that forced and other special processing is more costly than normal processing. The decision whether to use neg./pos. or reversal stock will also affect processing and print costs, and must be taken into account.

Rush print, for cutting-copy.

Approval and red case prints. Charges here will vary according to a number of factors: printing from A and B rolls, colour correction and grading, fades and dissolves produced in printing, printing of optical sound-tracks - these will all add to the cost of prints. Approval and single copies are also more expensive than subsequent copies: most labs have a scale of charges, reduced as the number of copies increase.

Optical printing for special effects - freeze-frames, image placement, reverse and stretch printing, for example - is expensive. An initial setting-up charged is usually made before the actual cost, charge by the foot, is calculated.

Negative or positive master for the optical sound-track. Magnetic striping of the film, if sound is to be magnetic. Additional services - such as master inspection, negative cutting, waxing of print, scratch treatment and so on - may be necessary.

Sound studio charges

Sound transfer from ¼ '' magnetic tape to 16 mm magnetic film. The charge for this normally includes the price of the virgin stock.

Hire of the dubbing theatre for the mixing of the tracks. This is charged for by the hour, and includes the services of the dubbing mixer. Allow for at least three times the running time of the film - even more if the tracks are complicated, or if any difficulty is foreseen.

Final transfer to magnetic stripe, for magnetic sound copies. This should only take the running time of the film, but setting-up time must also be allowed.

Studio time for recording commentary to film.

As noted earlier, hire charges can be high in a small budget, and if equipment is to be hired, efficient use should be made of it. Hire firms will supply their price list.

Additions to these basic budgeting requirements will vary from unit to unit, and items such as wages, overheads, depreciation of equipment, professional fees, commentator's fees, transport, overtime, insurance, copyright fees and other clearances, script-writer's and animator's fees must be costed according to the position of the individual film unit.

When the overall picture of the approved budget is clear, the money available for the basic production materials must be analysed in relation to the script of the film. At this stage, the amount of money available can materially affect the entire construction of an approach to the film. Organizational and filmic priorities may now be in conflict: Can colour be afforded, and if not, can it be dropped without seriously impairing the impact of the film? Does a freeze-frame written into the script really justify its cost in relation to the overall cost of the film? Will the money available allow for the amount of shooting estimated as essential in the script? Is synchronous sound essential to a scene, or could the sequence be equally effectively done with wild sound, and the cost of hiring expensive equipment saved.

On all but the very simplest films, the organization and setting-up process is a major and integral part of the finished product. Often, though, the planning of the film can seem, except marginally, to be an uncreative labour to be hurried through in order to get on to the actual construction of the film itself, and as such to be passed over lightly, especially in informal film units. But the organization of the film is in fact one of the vital keys to its success. A good script, sensitive and imaginative direction, gripping camerawork, editing and sound, are some of the obvious qualities that commend a film to its audience. But none of these is sufficient in isolation - indeed slackness in only one of these departments can seriously impair a film's quality; it is only by perceptive and thoughtful planning that, given individual skills and talent, the several aspects of a film's creation can be consistently and successfully brought together. Like the proverbial hour's sleep before midnight, an hour's planning before shooting begins may well be worth two hours afterwards.

THE SCRIPT

The script is the cinematic and practical embodiment of the idea of the film. A well-prepared script is a major part of the setting-up of the film, and it is probably the most obviously creative part of pre-shooting work.

The script is not only creative in relation to the more abstract aspects of the film - the ideas it contains, the attitudes it expresses - but also in the concrete cinematic expression that will give the film its identity. The disposition of long shots, medium shots and close ups will be established; the rhythm of the editing will be indicated; effective camera angles and provisions for cutting points will be considered; the inter-relation of the action and sound-track will be estimated; special effects will be specified, and many similar considerations will be thoroughly worked out. The real importance of creative thinking at the script stage is that it is then that it is possible to take a clear view of the film, undistracted by shot material, and to make considered formal decisions as to its overall construction, the development of its main ideas, and the way in which the filmic construction will embody these ideas. This is not, however, to deny that there is room for creative thinking at shooting and editing stages: obviously, detailed amendments and improvements will be made to the script during the making of the film; often the script can only indicate general ideas, and major decisions of all kinds will have to be taken while shooting and editing.

The following are only examples of the kind of areas that may have to be examined during the preparation of the script: each film will have its own specific requirements, and the script will reflect the individual nature of the film.

The idea and story. An original idea will need to be fully worked out and prepared for expression in the film medium. An adapted idea may have to be substantially restructured to make it suitable for film form in a documentary film material, an attitude and means of presentation must be established; in a technical film suitable means of demonstration must be found.

The length of the film. The length of time needed to put across the chosen interpretation of the idea should be envisaged, or alternatively, how best to film the required idea or information in a given time.

Balance of film. Within the overall length of the film, how are the sequences to be ordered and balanced to achieve the desired effect? The relative importance and length of the various sequences; the rhythmic shape of the film and its sequences; disposition of crisis and emphasis, and how these will affect the audience's reaction to the film.

The choice of filmstock and the visual appearance of the film. How will the visual surface of the film affect the audience's reaction to the content of the film? Black-and-white or colour? Grainy images or fine-grain? Contrasty, or with full tonal range? Hand-held sequences? Ideas about camerawork and composition? High-key and/or low-key lighting?

Special effects. Special effects draw the audience's attention, and so must be carefully used. Mattes, slow-motion, split-screen, etc., must be considered from the script stage. All cinematic expression requires forethought, and special effects in particular must be an integral part of the structure of the film, rather than an ornamental afterthought.

Editing patterns. Although the script-writer can hardly shackle an editor to preconceived notions about the detailed cutting of the film, he must visualize the broad pattern of the editor's work. The nature of the editing has a powerful influence on the appearance of the completed piece of work and its effect on an audience, and the scriptwriter must calculate for this in thinking about the film. Is a particular scene to be cut with a fast and exciting rhythm, or a slow and leisurely one? Is the editor to be allowed to experiment with continuity and so forth so as to heighten the impact of a certain sequence? Exactly what is the editor's involvement in the construction of the film to be? In a purely technical and closely scripted film, his main job may be only to find the right cutting points in an unalterable sequence of shots, while in a dramatic action scene or montage sequence he may be freer to decide what shots to use and the positioning and length of those shots.

What use is likely to be made of cutaways and reaction shots?

The sound-track. The sound-track must be thoroughly thought out as the visual aspects of the film. Decisions on what kind of sound to use and how to use it may be taken at script stage. Will a certain scene have to be shot sync, or would a wild track with a voiceover be more telling? Is a music track necessary, and if so,how will it be best used? How elaborate must the effects track be? How will the sound be edited, and how will it contribute to the editing of the action? How long will be needed for a commentary to impart its essential information, and will it underline, or complement the action? Are special sound effects wanted, and justifiable?

Actors, extras, costume, location, studio, sets and many other items for consideration will also appear at the scripting stage of various kinds of film. Details of all such requirements, and their integration into the film, must be decided before the film is shot.

There are five generally recognized stages in the preparation of a film script: the idea; treatment; screenplay or scenario; shooting script; shooting schedule.

DEVELOPMENT OF THE IDEA

This is perhaps not a well defined stage of script-writing; but before the writer presents his treatment, he will clearly have to spend much time in general consideration of the film. If the subject of the film is imposed on the writer, he will need to assemble his ideas about how it should be turned into a film; he will need to research the background and probably to discuss the needs, aims and contents of the film with its producer. If the subject is of the writer's own choice, the creative assembly of ideas - or the selection of the source for an adaptation - will need much work before the writer is in a position to produce the treatment. On the one hand, work at this stage of the script may be no more than discussion with the parties involved in the film; on the other it may appear a sheaf of personal notes, suggestions of alternatives, or even trial sequences actually shot. The method will depend both on the type of film involved and on the individual script-writer.

THE TREATMENT

The treatment is a fairly brief prose description of how the writer sees the film. It will normally concentrate on the content of the film, and will only broadly indicate the filmic interpretation of the subject. The structure of the film will be generally suggested, but the filmic details of individual sequences will not be elaborated. General practical observations will be included - estimated running time, how many, and which, actors, general locations and so forth. With a sponsored film, the treatment will be submitted for approval before work starts on the screenplay.

THE SCREENPLAY

At this stage the treatment is broken down into sequences, and analysed with a view to its expression in film form. The individual style of the film begins to emerge. The dialogue is written in, as well as the commentary, general sound effects and other sound-track matter. Details of the locations, interiors and exteriors, day or night sequences, are all indicated. The individual scenes are constructed; the dramatic and/or filmic shape of the film is now clearly specified and the atmosphere of the film should be quite clearly conveyed. The screenplay, in fact, is that stage of the script at which the film is most clearly described to a reader: earlier stages are too brief and general, while later phases are perhaps too full of technical details and instructions for a reader to be able to grasp the flow of the ideas, and to envisage the effect of the film.

THE SHOOTING SCRIPT

This is the complete, detailed breakdown of the film into shot-by-shot order, anticipating every shot that will be used, and how that shot will look. Every action and scene of the screenplay will be described in terms of individual shots: details will include type of shot (LS, MS, CU, etc), camera angles, atmosphere, subject movements and camera movements, even, possibly, cutting points. A story-board - really a visual presentation of a shooting script, with drawings taking the place of shot descriptions - may also be prepared at this point. In theory the test of a well-prepared shooting script is that if it is given to a competent director, cameraman and editor, they should be able to deliver a film that is very close in actuality to the script-writer's intention. In practice, of course, this does not happen: most directors and cameramen are not content to be merely competent, and in most cases the director works very closely with the script-writer, if indeed he is not the same man.

In documentary and news film-making, it is not always possible to make a detailed shooting script.

Suppose the film-maker is working on an idea for a film about a bauxite worker on his last day of work after many years in the pits. He has been thinking the idea over for some months, and he has made notes and has a clear picture of what he wants to say. The successive stages of the script will finalize his ideas, perhaps as follows:

Treatment. The film will look at some of the traditional hardships and problems of the worker. The life of one man, who has worked at the Kaiser plant for twenty years. A certain amount of archive material will be incorporated in the film, but by and large, reconstruction will not be used as a method of presentation. Instead, Mr. Blank will recount stories of the old days - some of the time in sync interview, some of the time in voiceover - and his stories will be illustrated by their modern counterparts, with shots of the present plant.

Screenplay. Scene I. Outside the plant, early morning. Jack, the subject of the film, is walking down the hill towards the main gate. He stops briefly, and looks over the plant. The workers are walking down the road in groups of two and three: the early morning sun lights up the white helmets, and the smoke form the big chimneys. The sounds of the pit are still fairly distant. As he watches, his face impassive, the siren for the end of the previous shift blasts suddenly. Jack starts slightly, and moves on down the road. Commentary starts:

"Kaiser opened in 1945...."

The same sequence could also be drawn as the story-board.

Alternatively, the shooting script should be laid out in a more formal manner on a sheet of paper ruled into columns:

Shot No.	Shot Size	Action	Sound-track	Remarks
1	CU	Jack's carrier swings as he walks	Natural sound, early a.m. outside plant.Jack's footstep heard on gravel	Fade-in at beginning. Hold for some time

The shooting schedule. This is strictly an administrative rather than a scripting job, and represents the breakdown of the shooting script into convenient work sessions for the camera crew. All scenes to be shot on the same location, for example, or all scenes requiring the same actors, will be grouped together for shooting, irrespective of their script order and final position in the film. Estimated time for shooting is included, as well as details of equipment and unit staff needed for the shooting session. In professional and large-unit film-making, a full shooting schedule is necessarily an essential administrative operation. Small units, or the lone film-maker, will obviously not need the same detail of written preparation, as long as the director is capable of organizing things successfully in his head. A shooting schedule might work out like this:

Day 1: Scenes 1, 8, 9 and final scene (17). Location: the plant, exteriors 1 and 17, interiors 8 and 9. Actors: Jack, four other miners. Equipment: sync camera and recorder; lights and two sun-guns; second camera mute, second tape-recorder for effects and background; camera dolly.

Note: Contact electrician and section manager for interior shooting....

And so forth, including all details, from permit to changing-rooms, of the anticipated day's shooting.

These then are the first stages in the preparation of the film script. It should be noted that the stages outlined are theoretical. In point of fact, many good short films made by individuals or small groups do not have scripts as thoroughly prepared as this; a film can be quite successfully made from a story-board alone, or even from a treatment if the scriptwriter is also the director. Furthermore, it should be emphasized that there are many kinds of film subject that do not lend themselves to rigorous planning in advance: once-off events, newsreel sequences, live interviews, informal occasions, and all those sequences where events and people are not in the control of the director, none of these can be given as thorough a shooting script as the one outlined above. However, scripting on these occasions is very important, even if it does not take the same form as other scripting. The location, for instance, can be visited and notes made on how it can best be used to the film's advantage; the good camera positions it offers; the angles which will make best use of it. Programmes can be obtained to give some idea about the nature and duration of the events; background information can be sought on people to be interviewed; and much other work can be done in preparation which will pay dividends in well-shot and sufficient material. A well-prepared film - whatever the detailed method of preparation - is well on the way to being a well-made film.

Outlined above is a general guide to the preparation of a film script. But what goes into the script, and how the proposed content of the film is adapted for cinematic presentation, is even more important to the film.

It is not possible here to go into details, but there are a number of relevant questions and decisions that can be proposed.

The problem can be quite simply expressed as a two-part question: what is the film (or the scene) saying (or doing)? What is the best way to say or do this in cinematic terms? The first part of the question must be readily answered by the film-maker, otherwise there is no film.

The second part needs much work and thought. As a brief illustration - it can be no more - of some of the things to be taken into consideration, let us look at one small section of a hypothetical script. Assuming that the subject and structure of the film have been decided upon, the scene now being worked on is a man sitting at a table writing; after a short time he gets up, walks to the window and looks out.

This simple bit of action can be covered cinematically in anything from one to fifty (or even more) shots, and each of these shots can be one of an infinitely variable number of possibilities. The number and kind of shots chosen will depend upon all kinds of factors: the nature of the film, the nature of the sequence within the film, the importance of the scene within the sequence, the complexity of the sound-track, and a host of similar circumstances. All of these must be weighed up before the decisions are taken. In addition, there are a number of cinematic factors that will remain constant throughout the scene, perhaps throughout the film, that must also be determined. The lighting of the scene, which has a most important bearing on the total effect, must be chosen (high key or low key, for example), and the photographic quality (granularity, black-and-white or colour, filters, special effects and so on), which is also crucial, must be specified.

The different ways of scripting and shooting this scene result from the following variables: number of shots; type of shots (LS, CU, etc.); length of shots; content of shots; angle of shot; composition of shot; camera movement; subject movement; rhythm of editing; the sound-track. These must be combined, by the judgement and experience of the script-writer, to produce the effect that is most fitting for the particular film.

Many films will, further, need a written script - commentary, dialogue and any other form of controlled spoken work used on the sound-track.

A commentary will not need to fill all the film time available. Short sections of commentary, spaced out with music, effects and perhaps even with other voice tracks, will usually be more effective than an uninterrupted blanket of information. A speaking rate of between two and three words per second is usual with commentators of a professional standard, and this can be taken as a rough guide when estimating the length of a written script.

Information is best imparted as concisely as possible. The information given should complement rather than describe the picture. There is no need to tell the audience what it can see for itself.

Finally, the power of the commentary should not be under-estimated; exactly the same piece of film can be completely altered in tone merely by changing the mood of the commentary.

In short, to write a successful script, the script-writer must be conversant with almost all aspects of film-making, and must be able to visualize the particular needs of each process.

LIGHT

THE NATURE OF LIGHT

The human eye can perceive objects only if they themselves either send out light or reflect light.

Light rays are electromagnetic oscillations with very small wave lengths. Each colour has a specific wavelength, and therefore a specific frequency of oscillation. The human eye can perceive wavelengths (colours) between 400 and 700 millimicron. All the other electromagnetic waves lie on one side or the other of the visible spectrum. Beyond the red end (700) are the infra-red or heat-rays, beyond the violet (400) are the ultra-violet. We cannot see infra-red or ultra-violet rays, but both kinds can affect the light sensitive filmstock, particularly the ultra-violet ones.

On the right side of the wave length scale visible light starts at approximately 780 millimicron with red and ends at approximately 390 millimicron with the colour violet. In between these two are all the colours visible to the human eye except the colour white.

White is not a single colour but is a combination of the seven colours of the visible spectrum.This can be demonstrated by painting sectors of the colours on a disc which, when revolved, will give a whitish impression. The seven colours which make up white light become separately visible in the form of the spectrum when white light has passed through a glass prism. The same prismatic effect can be seen when raindrops break up the light to form a rainbow.

Red has the longest and violet the shortest wave length, and that is why a glass prism breaks up white light into its separate colours: when light enters one side of the prism, the light is bent by the denser material and is thus refracted; on re-entering the air it is bent again, but having a different wave length, each colour is bent at a slightly different angle to the next; those with shorter wave length are bent more than those with the longer ones.

This demonstration can be reversed. If light rays of the different wavelengths (colours) are sent through a prism in the correct proportion, white appears.

The human eye has approximately 7,000,000 cells sensitive to colour, the cone cells, which are placed all over the retina. A light impulse stimulates them to produce an electric signal which is transmitted to the brain and there translated into a colour impression.

Three groups of cone cells can be distinguished according to their sensitivity to different wavelengths of the visible spectrum: those which respond to wavelengths between 400 to 500 (violet-blue), those responding to wavelengths between 500 to 600 (green-yellow) and those sensitive to wavelengths between 600 and 700 (orange-red). That means, that the human eye responds to three distinct regions of the spectrum and that any colour seen in normal vision, including white, is obtained by mixing the right amount of blue-white, green-yellow and orange-red.

The eye is most sensitive to green-yellow, slightly less to orange-red, and least of all to violet-blue. In other words, saturated violets and blues look darker than saturated yellows, greens and reds.

ADDITIVE AND SUBTRACTIVE COLOUR MIXING

As has been shown, the eyes do not see the colours of the visible spectrum as such, but obtain them through mixing. The same holds for colour film. Here too the colours recorded are attained through mixing.

There are two different ways to produce the recorded colours: the additive and the subtractive processes.

The visible spectrum can be divided into three equal portions, corresponding to the colours to which the cone cells of the eyes are sensitive. Though all three portions cover parts of the respective neighbouring colour, for practical reasons, these three parts are here called the blue, the green and the red portion.

Blue, green and red are the primary or additive colours. By combining them all other colours can be produced in the additive process.

If blue, green and red lights are mixed, for example, by setting up three projectors each producing one of the primary colours in such a way that the three different circles meet when projected on a screen the following mixed colours will appear: Green and blue will add up to cyan, red and green will result in yellow and red and blue will produce magenta. In the middle of the three circles, where all three primary colours overlap, white will appear. The mixed colours cyan, yellow and magenta, are each the result of the combination of two of the three basic colours. Therefore, this process is called the additive one.

To understand the subtractive process, it is necessary to keep in mind that all three basic colours combined result in white. Therefore, one can describe each of the three mixed colours obtained by adding only two of the primary colours as being white minus one of the additive colours. So for example, yellow (green + red) is white (blue + green + red) minus blue. The same applies to the other colours obtained through additive mixing: magenta (blue + red) is white light minus green, cyan (blue + green) is white light minus red. Each of them represents white light from which one of the primary colours has been subtracted. Therefore, yellow, cyan and magenta, are called secondary or subtractive colours. This implies that white will result if one adds the missing primary colour to the respective subtractive colour. So white will appear if one mixes, for example, magenta (blue + red) with green. Therefore, the lacking primary colour is the complementary colour to the respective secondary colour and vice versa, the secondary colour is complementary to its respective primary colour.

The principle of the subtractive process sounds more difficult than it is in reality. One only has to imagine that our eyes see the colours of the objects surrounding us by a subtractive process.

The human eye perceives the colours of an object, because the object either sends out light or reflects it. Most objects we see reflect the light of any light source (day/sunlight, or artificial light of any sort), and so transmit their colour. But the colour the eyes see is not the colour of the object as such, but those wavelengths which the object reflects. Under normal light conditions, for example, daylight, the light which hits an object is more or less white. If an object then appears white to our eyes, this is because it reflects all the daylight falling on it. If an object looks yellow to us, this is because it absorbs the blue part of the white daylight, i.e. subtracts blue from white and reflects green and red, which together add up to yellow. This means that every coloured object reflects its own colour and absorbs or subtracts all the others. A purely grey object absorbs an equal amount of all colours and reflects an equal amount. A black object absorbs all light falling on it and reflects none at all; black is the absence of light and therefore of colour.

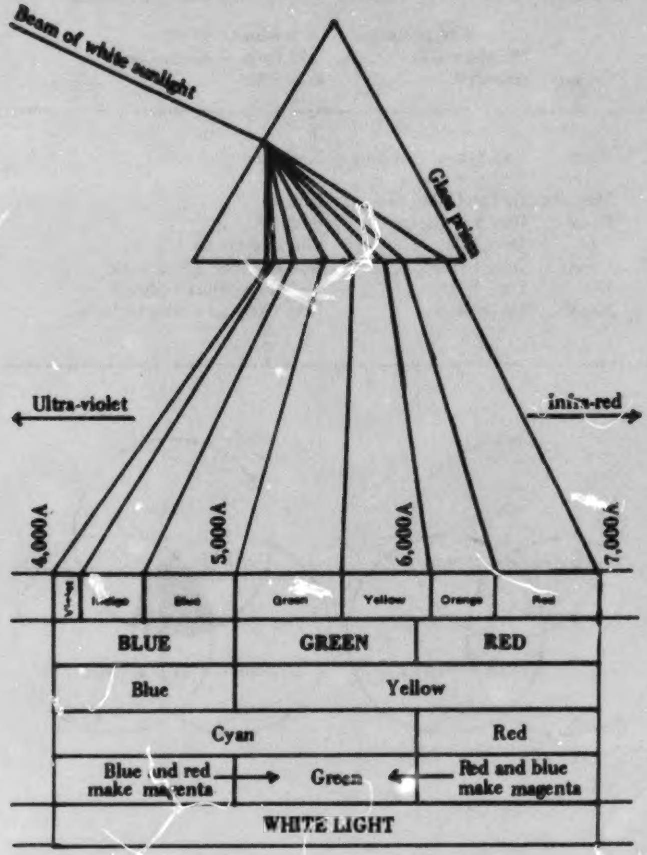
The fact that what we perceive as colour of an object is that part of the light falling on it which it reflects, is important to colour photography. If the light conditions change, the colours also will change; because the light source is composed differently, the reflected part will be different (see colour temperature).

Absorption or subtraction of light can also be achieved by artificial means; as it is done in colour photography. If one uses transparent but coloured filters or tinted gelatine layers, which absorb part of the light, only a specific portion will pass through and the colour content recorded will be changed. A yellow filter, for instance will swallow all blue portions of the light and transmit only green and red.

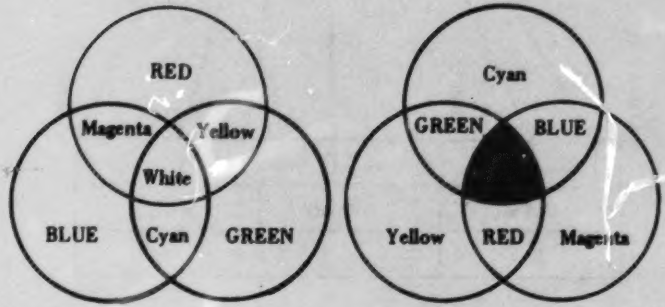
The process of additive colour mixing is based on the principle of combining the three primary colours, blue, green and red.

The process of subtractive colour mixing is based on the principle of removal. It uses the three subtractive colours, yellow, magenta and cyan.

The principle of removal in the subtractive colour mixing process can be demonstrated by piling up three glass panes or filters each of them dyed


Beam of white sunlight
Glass prism
Ultra-violet
infra-red
4,000A
5,000A
6,000A
7,000A
Violet
Indigo
Blue
Green
Yellow
Orange
Red
BLUE
GREEN
RED
Blue
Yellow
Cyan
Red
Blue and red make magenta
Green
Red and blue make magenta
WHITE LIGHT

Colour:	Consists in additions of light waves coloured:	Or it consists of white light from which has been subtracted:
White	Red, Green, and Blue	Nothing
Yellow	Red and Green	Blue
Magenta	Red and Blue	Green
Cyan	Blue and Green	Red
Red	Only Red	Blue and Green (Cyan)
Green	Only Green	Red and Blue (Magenta)
Blue	Only Blue	Red and Green (Yellow)
Black	No light	Red, Green and Blue (White)


RED
Magenta
Yellow
White
BLUE
Cyan
GREEN
Cyan
GREEN
BLUE
Yellow
RED
Magenta

in one of the three subtractive colours. In the middle, where all three colours overlap, black, the absence of colour will appear.

Additive colour mixing is the basis of colour TV. Subtractive colour mixing is the basis of colour photography.

The principle of additive colour mixing is the combination of blending of the three basic colours. Very small dots of the basic colours are placed side by side. If, for example, red and green dots are situated closely beside one another, the over-all visual impression will be that of yellow colour.

In the subtractive colour mixing the three colours are situated as layers, one over the other. Since the different layers are only partly transparent, not all light passes through them, but part of it is absorbed (see filmstocks).

COLOUR TEMPERATURE

As the three primary colours, red, green and blue, are very rarely seen in pure form, light which is purely white hardly exists in reality. Depending on the type of light, the portions of the different spectral colours differ in all light which is perceived as white. Daylight contains far more blue than light from a photoflood lamp which in turn contains more blue than the light from ordinary domestic light bulbs. Sunlight shining through clouds at midday will contain more blue than direct sunlight in the early morning or late evening which may be very red in content.

Our eyes are not able to calculate the spectral composition of light, because our subjective impression of colours adjusts itself to the predominant "colour" of the light source. Since the colour of the light will affect the colour rendering on the film, an objective measuring instrument which records the spectral composition of the light is necessary.

The colour composition of the light source is defined as its colour temperature. The connection between colour and temperature derives from the characteristic of the light of glowing bodies. A piece of metal placed in a fire will first be black, soon beginning to glow red, then orange, and if heated high enough, it will become white hot. The higher the colour temperature, the bluer the light becomes and the red rays are weakened. Colour temperature is measured in °K (degrees Kelvin) °K = °C + 273 with a colour temperature meter. The concept of colour temperature is also used for light not emitted by a glooming substance.

Colour temperature meters record the ends of the spectrum, i.e., the difference between red and blue. This is sufficient for all light sources which have a constant spectrum, i.e., most lights important to photography. But care has to be taken when using light from a flourescent tube. They do not have a continuous spectrum, but contain more or less pronounced colour parts, which can have a devastating effect on the film.

FILMSTOCK

Since the filmstock used highly influences the result, profound knowledge of the different types of filmstock and their peculiarities is indispensable.

First of all, one can distinguish two basic sorts of filmstock available in black/white and in colour for exposure in the camera: the negative and the reversal film.

If negative filmstock was used for exposure a positive copy (print) has to be taken for projection. Therefore, this sort of film is usually called negative/positive (neg/pos). If the film was shot on reversal stock, it can be projected immediately after processing. But normally in professional film a duplicate is made, to prevent damage during projection and editing.

So, in the camera either negative or reversal filmstock is exposed, in the lab, positive or duplicating filmstock is used to make copies, or prints.

The choice of filmstock should be made before shooting, because intercutting between different types of stocks is difficult.

Comparison : Negative/Reversal Filmstock

Negative Filmstock		Reversal Filmstock	
Advantage	Disadvantage	Advantage	Disadvantage
More control in developing corrections possible; more exposure latitude, processing and printing costs are lower than with reversal	To process a positive for projection takes double the time as with reversal	Quick processing; reasonably priced	Duplicate copies (prints) are more expensive than positive copies of a negative film

Filmstock is supplied on daylight loading spools or it is wound on cores for loading into magazines, with the emulsion facing inwards. Film wound on cores must be loaded in total darkness.

To enable the film to be transported, filmstocks are perforated either on one side (single perf.) or on both sides (double perf.).

Nearly all cameras are able to transport film with both types or perforation.

Filmstocks are available in the following lengths:

16 mm : 100 ft. (daylight); 200 ft. (daylight);
400 ft. (daylight & cores); 1200 ft. (cores).

35 mm : 100 ft. (daylight); 200 ft. (cores); 400 ft. (cores);
1000 ft. (cores); 2000 ft. (cores).

STRUCTURE OF FILMSTOCK

In principle all filmstocks, no matter what type, consists of two different and distinct portions;the film base and the emulsion.

The film base is made from cellulose acetate, which is flame proof. The thickness of the base of professional motion picture film is approximately 0.13 mm.

Unto this film base the light sensitive emulsion is coated. This photosensitive emulsion is the essential part of all filmstock. Because of its chemical characteristics, it is affected by light in such a way that objects are recorded. In the case of less sensitive filmstocks, for example, positive film, the thickness of the emulsion is approximately 6 to 10 micron.

Highly sensitive filmstocks, for instance, negative film, normally have two layers of emulsion coated one over the other, which together amount to approximately 15 to 20 micron. The upper layer is highly sensitive, the lower layer is less sensitive, but it increases the latitude of the filmstock. Colour filmstocks today generally consist of three layers of emulsion. Furthermore, the uppermost layer is separated from the others by a layer of tinted gelatine which acts as a filter. The thickness of the total emulsion of colour filmstock is approximately 20 to 22 micron.

Some filmstocks have a very thin gelatine layer on top to protect the emulsion. Most of the light which strikes the film during exposure is either absorbed or passes through it. But a part of the incoming light is scattered by the small particles in the emulsion or reflected by the base itself. This is called halation. To avoid halation, the emulsion or the film base is dyed, or, in colour films, a jet black backing is used on the outside of the film base.

THE LIGHT-SENSITIVE MATERIAL

Constituents

The photographic emulsion has two principal ingredients, silver halide crystals and gelatine. The silver halide crystals, which form the light-sensitive medium, are held apart from each other by the gelatine, which acts as a colloidal binder. A colloid consists of a fine suspension of microparticles in a medium. If a colloid is in a fluid state it is called a sol, while if it is in a solid state it is called gel. Gelatine is an example of a colloid, which is a sol above a certain temperature and a gel below it. The photographic emulsion is a type of colloid.

THE PHOTOGRAPHIC EMULSION

The Binder

The silver halide grains, or micro-crystals, which are the light-sensitive components of standard photographic emulsions, are insoluble in water. Thus silver halide which is formed by precipitation in the absence of any other medium will coagulate into a creamy curd, and in this form is quite unsuitable for spreading evenly on a support material. This means that it is necessary to employ a substance, known as a binder, which will effectively disperse the grains of halide as they are formed and ensure that they adhere permanently to the support. The substance used for this purpose is gelatine, an organic compound belonging to the protein group which is extracted from bones and hide clippings of cows and pigs. Discovered in 1871 gelatine has since remained unrivalled as a binder despite scientific research.

Gelatine Binder

Gelatine is the binder material nearly always used. It has the following desirable properties:

(a) When dry it is strong and tough, securing the silver halide grains firmly to the support, and protecting the emulsion from physical damage by abrasion.

(b) It holds the halide grains apart and dispersed throughout the emulsion.

(c) When dissolved in water, it provides a convenient medium in which solutions of silver nitrate and alkali halides can be brought together to form crystals of water-soluble halide. The water-insoluble silver bromide produced is immediately precipitated out of solution and in the absence of gelatine the resultant mixture clouds over; the crystals so formed coagulate at once and settle to the bottom of the container as a pale yellow curd. In the presence of gelatine, however, the silver bromide is held in a clear yellow colloidal suspension which remains transparent for some time.

(d) During the coating operation, the emulsion must be applied in the form of a sol, becoming a gel afterwards. In gelatine the change from a sol to a gel takes place at a convenient temperature and is reversible.

(e) When dry gelatine is placed in water it swells, and this allows penetration of processing agents in solution. The amount of swelling depends on the pH value and the salt concentration of the solution. The swollen gelatine is extremely soft and is easily penetrated by small-sized molecules, such as those of developers.

(f) Gelatine is stable with time.

(g) It acts as a sensitizer.

(h) It prevents the reduction of unexposed silver bromide crystals. This it does by becoming adsorbed to the crystal, producing a barrier which results in a difference in the rate at which the exposed and unexposed crystals are attracted by the developer. Adsorption is the condensation in the form of a film, of molecules of a suspended substance upon the surface of a solid.

(i) It is fairly easy to manufacture in bulk in a reproducible manner.

(j) It serves to regulate the sizes of the crystals formed when the silver halide is precipitated and provides a suitable environment for modifying the crystal size.

Choice of Halides

The chosen halide for a particular emulsion depends upon the purpose for which the emulsion is designed. Silver chloride alone or in combination with bromide, is in common use for certain types of printing papers in still photography, but its application in motion picture work is confined to some colour printing stocks when its insensitivity to blue light can be exploited to good advantage. Silver bromide, being more sensitive to light in general, and to the blue region of the spectrum in particular, is otherwise universally adopted in the motion picture industry, for both negative and positive film. It is often used in conjunction with a small proportion, up to 5 % silver iodide, which, though unsuitable for use on its own, considerably increases the speed of bromide emulsions when employed in small amounts.

Emulsification

Silver halide may be formed by direct combination of metallic silver and a halogen, i.e. : flourine, chlorine, bromine or iodine. The method employed in the regular production of photographic emulsions, however, involves the mixture of solutions in an emulsion "kettle". Metallic silver is first dissolved in dilute nitric acid which is then placed in solution with water. A solution of an alkali (e.g. potassium) halide is then mixed with the silver nitrate solution in the presence of gelatine and a double decomposition reaction takes place.

The way in which the emulsification takes place determines the initial size and size-range of the silver halide grains, which may be modified but not radically changed in later stages of emulsion manufacture. Since grain size distribution is of crucial importance to the ultimate contrast, speed and graininess of an emulsion, the factors which influence it during emulsification are very carefully regulated. These factors include:

(a) The rate of emulsification.
(b) The manner of emulsification (intermittent or continuous).
(c) The temperature at which emulsification takes place.
(d) The concentration of the gelatine.
(e) The concentration of silver nitrate (or ammoniate) solution.
(f) The concentration of alkali bromide solution.
(g) The relative proportions of original solutions.
(h) The amount of ammonia (if any) employed and the manner in which it is added.

By regulating the complex chemical interactions which take place between these variables, filmstock manufacturers are able to produce emulsions with a wide range of potential characteristics.

EMULSION CHARACTERISTICS

The most important characteristics of an emulsion are its contrast, speed and graininess. All of these may be strongly modified by the type of development which the emulsion is given; nevertheless, it is perfectly legitimate to speak of a filmstock as being "high contrast", "fast", "fine grained", etc., it being understood that these characteristics apply when standard processing is employed.

Contrast describes the way in which an emulsion responds to given variations in exposure. If these variations produce large differences in blackness or density of the developed image, it is said to be "high contrast" emulsion.

High contrast materials have a tendency to exaggerate and compress light and dark tones. If corresponding exposure variations produce relatively small variations in density, the emulsion is said to be "low contrast" and such materials generally have the ability to reproduce faithfully a wide range of greys.

Speed refers to the sensitivity of the emulsion: with a "high speed" emulsion, a given exposure will affect comparatively high proportion of the silver halide grains.

Graininess describes the subjective impression produced by the apparent "clumping" of silver grains in a photographic image when it is enlarged and is directly proportional to grain size. During emulsion manufacture, the sensitivity of grains may be increased without altering their size by subjecting them to certain treatments such as the addition of iodide and after-ripening.

Once these treatments have been adjusted to produce the optimum benefit, however, it is found that the sensitivity of a grain is directly dependent upon its size: the larger the grain the more sensitive it is. For this reason the chief characteristics of an emulsion all depend upon its grain size distribution; if the grains are similar in size, contrast will be high. This is because the sensitivity of all the grains over an area of the emulsion will be roughly the same and thus above a certain exposure level all the grains will become developable; below it, none of them will. A large size range, on the other hand, will produce low contrast, since the number of developable grains will gradually rise with small increments in exposure.

The speed of an emulsion depends upon the sensitivity, and hence the size of the more sensitive grains. Graininess, therefore, tends to be directly proportional to speed.

Emulsions are made with a wide variety of characteristics but may be broadly divided into two classes:

(1) High contrast emulsions which tend to be slow and fine grained are produced by restricting the size range of the halide grains and are widely used for motion picture positives, variable area sound recording film and titling stock.

(2) High speed emulsions which tend to be of low contrast and relatively course grain, have a comparatively large average grain size and a broad grain size range. Most negative materials belong to this class.

The emulsion is subjected to a heat treatment known as ripening. This process affects the number of grains, increases the average grain size and expands the range of grain size.

After ripening, the emulsion is chilled into a gel and shredded into small strips. Soluble components present during ripening (excess ammonia, alkali, nitrate, etc.) are then removed by washing in running water.

Another heat treatment known as 'after-ripening' then takes place and has important influences on grain size distribution established during ripening, the presence of sensitizers and the time of after-ripening.

DYE SENSITIZING

Irrespective of light intensity, silver halides without special treatments are monochromatic, sensitive only to ultra-violet, violet and blue light. By the addition of certain organic dyes called spectral sensitizers, however, this range may be extended to include other regions of the spectrum.

Non-colour sensitized emulsions are perfectly satisfactory in some applications such as b/w printing stock.

Orthochromatic film contains dyes which extend the sensitivity range to include green and yellow.

Panchromatic emulsions contain dyes which extend the range to include the whole of the visible spectrum (or nearly so). Most negative emulsions for b/w photography are of this type.

The principle of dye sensitization is widely used in colour photography, notably in the design of integral tripack filmstocks. Coating of the emulsion takes place at this stage by passing the film base over a system of rollers and by bringing into contact with the liquid emulsion. This is a critical operation as the thickness and uniformity of the emulsion layer will affect the photographic characteristic of the film, and so must be held to rigid specifications.

SPEED RATING

Sensitivity or speed of a filmstock is measured on several scales in different countries. In the U.S.A. and England, the American Standard Association's (ASA) scale is most widely used.

ASA is an arithmetical scale. This not only means that the higher the ASA number, the more sensitive is the film, but also that the steps between the ASA numbers are evenly spaced. Therefore, filmstocks rated as ASA 250 will need half the intensity of light than one rated as ASA 125.

As has already been mentioned, sensitivity of an emulsion is a variable of the size of its grains. The longer the grains have ripened, the more sensitive, but also the bigger they are. The bigger the grains, the lower the definition and resolution. Since latitude and gamma also depend on the granularity of the emulsion, a highly sensitive film will show less latitude and will have a more limited gamma characteristic.

Therefore, a highly sensitive film will allow to shoot even when the intensity of light is low, but the resulting picture will be less sharp and well defined, will show less tonal values and will look grainier.

From a purely technical point of view, the best results will be achieved with a less sensitive filmstock, which will give a very well focussed picture and a variety of tonal values, but which will need a high intensity of light to give a satisfactory image.

INFLUENCING THE CHARACTERISTICS OF FILMSTOCKS

The resulting photographic image is not only dependent on the type of emulsion but also on exposure and processing. One can influence the result during shooting and development.

The sensitivity of a filmstock normally is marked on its packing. Generally the recommended emulsion rating should be followed while shooting.

But there are cases when the need for adjustment may arise, because the calibrations on the equipment are slightly inaccurate, or when the lighting conditions are extremely unfavourable. Then the normal emulsion rating may be "overrated" during filming and forced during development.

Forcing results in an increase of graininess and also contrast. In the case of b/w filmstock the recorded image will not only look grainier but will also show less definition and will contain less grey values. With colour film, the more a filmstock is forced, the more its colour rendition will be affected. Some filmstocks allow considerable degrees of forcing without significant loss of picture quality.

If filmstock is used other than at its normal emulsion rating,care must be taken to clearly mark the adjustment on the packing and on the report sheet when the film is sent to the lab. Once a decision had been made to adjust the rating of a film, the whole roll should be exposed in the same way.

COLOUR FILMSTOCKS

Colour filmstocks are also coated with black/white emulsions. But the emulsion is composed of three different light sensitive layers which each respond to different wave lengths (colours).

Today, colour filmstock is made out of three separate and different b/w emulsions which are coated one over the other on the film base (multi-layer system). The uppermost layer consists of a monochromatic emulsion, sensitive only to ultra-violet, violet and blue light. The second layer is made from an orthochromatic emulsion, which responds to blue and green. The bottom layer is composed of a special type of panchromatic emulsion which is sensitive to blue and red but only slightly to green rays. Since all emulsions, no matter what type, are sensitive to blue light, the uppermost layer is separated from the others by a thin yellow gelatine layer which acts like a filter and absorbs all blue light. Therefore, blue light is only registered by the uppermost layer, green one by the middle layer and red one by the lowest layer of the emulsion. Mixed colours are recorded by both these layers which are sensitive to the respective primary colours.

Since the emulsions are b/w ones, the different wavelengths are recorded as different densities of silver, not as colours as such. The colours are attained through processing. This is based on the fact that when a developer reacts with silver bromide to reduce it to silver, the resulting oxidised developer can react with certain dyeforming chemicals (called couplers) to form dyes.

Two methods to develop colour film can be distinguished: the reversal and the negative processing. Both methods work according to the principle of subtractive colour mixing.

REVERSAL PROCESSING

The exposed film is first developed in a normal black and white developer in which the latent image is converted to silver; at this step no colour image is produced. The remaining undeveloped silver halide is then uniformly exposed, or in some cases chemically treated so as to convert it to a latent image which can be developed at the next step in a colour coupling developer, so as to produce coloured dye images corresponding to areas which were not originally exposed. The whole of the silver produced by both developing operations is then bleached and removed by fixation, so that the final result is a colour positive image on the film originally exposed in the camera.

NEGATIVE-POSITIVE PROCESSING

The negative film also consists of three layers separated by a yellow filter layer.

Negative colour film is processed in colour in the first development. In doing so the blue exposure impression is reproduced as the colour yellow, the green impression as magenta and the red one as cyan. The silver negative is bleached out and a negative, with colours complementary to the colours of the original subject, is attained.

To obtain a positive, a three layer positive colour film is exposed to the negative. Hereby the part which is yellow on the negative leaves an impression on the red and on the green sensitive layers of the emulsion, since yellow is composed of these colours. While processing the positive film, the complementary colours are developed in the respective layers, i.e., the parts which have been yellow on the negative create the impression magenta and cyan which, added together in subtractive mixture, result in blue, the original colour of the depicted object.

In the reversal process, the natural colour of an object is recorded through the inverse density (blackness) of the black and white layers. The reversal process results by exposure to pure white light without any interference of colour. This exposure adds to the original object brightness, densities (blackness), which define the proportion of the mixed colours which result in the original colour of the object. In the case of the negative-positive process, the final colour impression is not defined directly by the natural colours of the original, but is determined by the "artificial" colours of the negative.

In this sense the printing process is comparable to a second exposure. The positive, therefore, is a complementary picture of the negative and its lighting and not of the original subject. Colour characteristics of the negative and the composition of the light source during processing have therefore a more marked impact on the result than is the case with reversal processing.

While working with colour filmstock, there is one important factor to consider which does not apply to b/w film: the quality of the light illuminating the subject, i.e., the colour temperature.

Colour filmstock is balanced for light with a specific colour temperature. The three most used colour temperatures for films are 5.800°K for daylight type films; 3.400°K for films balanced for photoflood lamps, and 3.200°K for films balanced for the slightly warmer studio lamps.

If colour film for artificial light is exposed in daylight, a pronounced blue cast will pervade the colour, while if a daylight film is used under artificial lighting, it will show a distinctly orange tinge. If the light for colour exposure matches exactly with the colour temperature of the emulsion, proper recording will result.

Normally, however, the light available does not always have a colour temperature which corresponds with the filmstock. Therefore in most cases, one has to work with colour correction filters (see the chapter on filters).

If one has to make adjustments, one should keep in mind that a conversion from artificial light to daylight produces better results than the reverse, which is not always satisfactory.

There are some other factors to consider when using colour filmstock. The brightness ratio that colour films can accept is considerably less than that suitable for b/w emulsions. The brightness ratio of a scene is measured by the relation of the intensity of the brightest area to that of the darkest. Whereas a b/w emulsion can accept brightness ratios of up to about 20:1 and still produce acceptable photographic images, a brightness ratio of a scene is measured by the relation of the intensity of the brightest area to that of the darkest. Whereas a b/w emulsion can accept brightness ratios of up to about 20:1 and still produce acceptable photographic images, a brightness ratio of 8:1 may be too much for a colour emulsion to cope with without colour distortion or over- or under-exposure on either the brightest, or the darkest part of the scene. Lighting therefore must be carefully regulated, or, if this is not possible, some compromise will have to be made in the exposure.

Exposure must always be very carefully calculated. Moreso with colour film. With b/w film, errors of up to one or two stops may still produce quite acceptable pictures. In the case of colour film the margin of errors is very small, errors of more than one-third, or at the most half a stop may result in a significant loss of picture quality.

Different emulsions give sometimes very different colour rendering. It is important not to mix different filmstocks, particularly within one scene. It is preferable to use one type of raw stock with the same emulsion number during an entire production.

Most colour stocks have associated printing stocks, and are balanced to give best colour rendering on that stock. This must be borne in mind when ordering the final print.

Finally, colour master, even though reversal, should never projected. Ideally, b/w reversal master should also not be projected. Colour emulsions are sometimes physically very soft, and are more prone than b/w master to damage in the projector or editing machine.

A GUIDE TO SOME WIDELY USED BRANDS OF FILM

16 mm Black and White Filmstock

Manufacturer: Kodak

Negative Filmstock:

Eastman XT 7220 (16 mm) 5220 (35 mm)

A slow speed filmstock with very fine grain to be used mainly for outdoor shooting under good light conditions. This stock is especially suitable for shooting rear-projection and for other optical effects which require good definition and little graininess.

Sensitivity:	daylight	25 ASA
	artificial light	20 ASA

Eastman Plus X 7231 (16 mm) 4231 (35 mm)

A filmstock with excellent definition, fine grain and medium speed. Especially suitable for shooting objects which show many small details.

Sensitivity:	daylight	80 ASA
	artificial light	64 ASA

Eastman Double X 7222 (16 mm) 5222 (35 mm)

A panchromatic filmstock which can be considered as a general purpose stock for indoor and outdoor shooting.

Sensitivity:	daylight	250 ASA
	artificial light	240 ASA

Eastman 4-X 7224 (16 mm) 5224 (35 mm)

A high speed filmstock with medium granularity. Especially suitable for newsreel and documentary films since it allows shooting under bad light conditions.

Sensitivity:	daylight	500 ASA
	artificial light	400 ASA

Reversal Filmstock:

Kodak Plus X 7276

A panchromatic filmstock of medium speed with fine grain and good definition. Its brightness ratio is especially high. A very good general purpose stock.

Sensitivity:	daylight	50 ASA
	artificial light	40 ASA

Kodak Tri-X 7278

A panchromatic filmstock with high speed which gives a full tonal range. Especially suitable for shooting under bad light conditions. This stock is not suitable for forcing.

Sensitivity:	daylight	200 ASA
	artificial light	160 ASA

Positive Filmstock:

Eastman High Contrast 7362

A positive filmstock with higher contrast than the normal

Eastman Positive Film 5302. Therefore 7362 is especially suitable for titling, masks, and all purposes which require very high contrast.

Eastman 7302 (16 mm) 5302 (35 mm) filmstocks are used for making release prints.

Manufacturer: Agfa Gevaert

Gevapan - 30 - 166

A medium speed b/w 16 mm film that possesses excellent characteristics of tonal range and grain. Similar to Eastman Plus X 7231.

Sensitivity: daylight 80 ASA
artificial light 64 ASA

Gevapan - 36 - 195

A b/w filmstock similar in quality to Eastman Double X 7222 and suitable for adverse lighting conditions.

Sensitivity: daylight 250 ASA
artificial light 200 ASA

Manufacturer: Ilford

Ilford FP 4

A negative filmstock which makes a good general purpose medium speed film with fine grain.

Sensitivity: daylight (normal) 80 ASA (minimum) 160 ASA
artificial light (normal) 64 ASA (minimum) 125 ASA

Ilford Mark V

A negative filmstock which is remarkably versatile, giving excellent results when forced as far as ASA 500. Therefore an excellent film for use where light levels are very low, or to produce contrast in dull and flatly lit subjects.

Sensitivity: daylight (normal) 250 ASA (minimum) 500 ASA
artificial light (normal) 200 ASA (minimum) 400 ASA

16 mm Colour Filmstock

Manufacturer: Agfa Gevaert

Gevacolor Negative T 6.80

A double-screened negative stock with very good definition and fine grain. Can be processed in the standardized CD - 3 process. Because of its screening positive copies made from the T 6.80 show highly saturated colours and very good colour rendering.

Sensitivity:	artificial light, 3,200°K	100 ASA
	daylight (with CTO 8 B Filter or Wratten Filter 85)	64 ASA

Necessary illumination (appr. 1/50 sec., artificial light 3,200°K)

f-stops	2	2.8	4	5.6
foot candles	50	100	200	400

Gevacolor Print Type 9.86

A positive colour stock for processing in a developing solution with 2-amino-5-diethylaminotoluol-monohydrochloride as developing agent. Not only the same bath but also the same time schedule as for other positive colour stock can be employed, as long as their development is based on the same developing agent. The definition of this stock is excellent and it is especially suitable for 16 mm copies. It is available in the following gauges: 35 mm, 35/16 mm, 35/8 mm, 16 mm and 16/8 mm. All sizes can be supplied with a magnetic stripe coated on the raw filmstock.

Gevacolor Print Type 984, Low Contrast

This printing stock has approximately 15 % less gradation than type 9.86 and with its flat emulsion is better suited for copies for TV transmission.

Gevachrome Reversal

Gevachrome - T 7.00

A colour reversal stock for shooting with artificial lighting at 3,200°K. It has a fine grain and gives a very sharp image. It is very suitable for making projection copies and has a photographic latitude of $\Delta \log E = 2.10$.

Sensitivity: artificial light, 3,200°K 80 ASA
daylight (with CTO 12 B filter) 40 ASA

Necessary illumination (appr. 1/50 sec. with artificial light)

f-stops	1.4	2	2.8	4	5.6	8	11
foot candles	32	64	125	250	500	1000	2000

Gevachrome T 7.10

A high speed reversal colour stock for TV which retains reasonable fineness of grain in relation to its speed. It is balanced for artificial lighting at 3,200°K. It shows good definition and colour saturation. Since it can be forced up to 3 f-stops it is especially suitable for newsreel and documentary films.

Sensitivity: artificial light, 3,200°K 125 ASA
daylight (with CTO 12 B filter) 64 ASA

Necessary illumination (appr. 1/50 sec. with artificial light)

f-stops	1.4	2	2.8	4	5.6	8	11
foot candles	20	40	80	160	320	640	1280

Gevachrome D - T 7.20

A TV newsreel colour reversal film for shooting in daylight. It has the same characteristics as T 7.10 but can be forced only up to 2 f-stops. Using it for artificial lighting can only be recommended when the colour temperature of the light source is very close to that of daylight. Generally it is not suitable for artificial lighting, because the necessary CTO 12 B filter would require an exposure of 2¼ f-stops more.

Sensitivity: daylight 6000°K 125 ASA
daylight 8000°K (with CTO 4 B: CTO 2 B + CTO 4 B = CTO 6 B) 100 ASA
daylight 10,000 - 12,000°K (with CTO 2 B + CTO 4 B = CTO 6 B) 100 ASA

Necessary illumination at 6000°K (appr. 1/50 sec.)

f-stops	1.4	2	2.8	4	5.6	8	11
foot candles	20	40	80	160	320	640	1280

Gevachrome II Print T 7.80

A filmstock for printing which is processed with the Gevachrome II method. Regarding sharpness of the image and granularity, it gives very good results. Because of its gradation, copies on this printing stock are especially suitable for TV transmission.

Gevachrome Print T 9.03

A colour reversal printing stock which is especially suited for optical soundtrack.

Manufacturer: Kodak

Eastman Color Negative II Film, Type 7247 (16 mm); 5247 (35 mm)

A negative colour stock for indoor and outdoor shooting. It is balanced for 3,200°K colour temperature. It gives very good colour rendering and sharp images, has very fine grain and a high exposure latitude. It has to be developed in the ENC-2-process.

Sensitivity:	artificial light 3,200°K	100 ASA
	daylight (Wratten filter 85)	64 ASA

Necessary illumination (appr. 1/50 sec. artificial light 3,200°K)

f-stops	2	2.8	3.5	4	5.6
foot candles	50	100	150	200	400

Eastman Ektachrome Commercial Film 7252

A slow colour reversal filmstock with low contrast. Copies made from this stock show excellent quality. It is balanced at 3,200°K. To be developed in the Kodak ECO-3-process.

Sensitivity: artificial light 3,200°K 25 ASA
daylight (Wratten filter 85) 16 ASA

This filmstock can be forced up to 50 ASA (artificial light) and up to 32 ASA (daylight).

Necessary illumination (appr. 1/50 sec. artificial light 3,200°K)

f-stops	1.4	2	2.8	4	5.6	8
foot candles	100	200	400	800	1600	3200

Kodak Ektachrome MS Film 7256 (16 mm) 5256)(35 mm)

A colour reversal stock for outdoor shooting under bad light conditions. This filmstock should not be used with artificial lighting. To be developed in the Kodak ME-4-process.

Sensitivity: daylight 64 ASA

Necessary illumination (appr. 1/50 sec. daylight)

f-stops	1.4	2	2.8	4	5.6	8
foot candles	35	70	140	280	560	1100

Eastman Ektachrome Video News Film 7239 (daylight)

Very sensitive colour reversal filmstock for outdoor shooting under bad light conditions and for high-speed cinematography. This filmstock can be forced up to 3 f-stops. To be developed in the Kodak VNF-1-process.

Sensitivity: daylight 160 ASA

To use the filmstock with artificial lighting should be an exception.

Sensitivity: artificial light
3,200°K (with Wratten filter 80A) 40 ASA
3,400°K (with Wratten filter 80B) 50 ASA

Necessary illumination (appr. 1/50 sec. daylight)

f-stops	1.4	2	2.8	4	5.6	8
foot candles	15	30	60	125	250	500

Eastman Ektachrome Video News Film 7240 for artificial lighting

Very sensitive colour reversal filmstock for artificial lighting under bad light conditions. Balanced at 3,200°K. This stock is especially suitable for difficult indoor shooting, for example, , in industrial films, also for shooting sports events illuminated with floodlight, for high-speed cinematography and for newsreels. This filmstock can be forced up to 3 f-stops. To be developed in the VNF-1-process.

Sensitivity:	artificial light	
	3,200°K	125 ASA
	3,350°K (with Wratten filter 81A)	100 ASA
	daylight (with Wratten filter 85B)	80 ASA

Necessary illumination (appr. 1/50 sec. artificial light 3,200°K)

f-stops	1.4	2	2.8	4	5.6	8
foot candles	20	40	80	160	320	640

Manufacturer: Fuji Film

Fujicolor Reversal Filmstock RT 400, type 8425 for artificial lighting

A very high speed filmstock which is especially suited for TV newsreel. Balanced at 3,200°K.

Sensitivity:	artificial light 3,200°K	400 ASA
	daylight (with Fujifilter LBA 12 or Wratten filter 85B)	250 ASA

Fujicolor Reversal Filmstock RT 100, type 8426 for artificial lighting

A less sensitive colour reversal filmstock. It is also balanced for a colour temperature of 3,200°K.

Sensitivity:	artificial light 3,200°K	100 ASA
	daylight (with Fuji filter LBA 12 or Wratten filter 85B)	64 ASA

THE CAMERA

How does the film camera function?

The film camera is the basic tool of the film-maker. The handbook supplied with each camera will provide all particular details. Therefore a brief description of points common to all film cameras and their general features will suffice here.

Exposure of the light sensitive emulsion of the filmstock depends upon the following factors: conditions of light, film sensitivity (speed), lens aperture and exposure time. A camera is a light tight box which allows light to fall only on the area of sensitized material. The amount of light coming in is controlled through the aperture setting and the exposure time (shutter speed).

In the case of a photographic camera one picture after another is exposed. After the exposure of each individual frame, the film has to be transported to be ready for the next shot.

In principle, the film camera is a still photographic camera, which records frame after frame. But since the effect of motion on the screen is produced by the rapid succession of photographic images recorded and projected, the film has to be transported automatically in a specific rate of many images per second. So the film camera takes a fixed number of frames per second according to its running speed, normally 24 or 25 f.p.s.

Since the frame frequency is determined, exposure time is fixed.

Therefore the amount of light which strikes the film is generally only controlled through the adjustment of the aperture of the lens.

A motion picture is composed through a succession of images, but this is succession of still images. The film has to be transported in an intermittent way.

It is held still, when each frame is exposed to the light, and is advanced by the space of one frame when no light reaches the film. Thus, instead of a continuous movement of the film, there is an intermittent motion with a rapid alternation of still and moving phases. A running speed of 25 f.p.s. means that 25 times per second a new frame is transported in front of the gate.

While the shutter is closed, a claw projects into a perforation and pulls the film down one frame. It then hesitates to steady the film and is retracted. While the shutter is open, the claw raised again ready to repeat the cycle. While the claw is being recovered, the film is held stationary by registration pin(s), which project into the perforations. On some cameras there are no registration pins, but a spring loaded pressure plate which holds the film simply by exerting pressure on the perforation area. This is obviously a less accurate method than the registration pin system.

The camera shutter is the mechanism which makes sure that each frame is exposed exactly during the time it is held still in the gate and which also makes sure that no light reaches the film while it is transported. The shutter opens and closes, interrupting the light coming from the lens. Depending on the running speed of the camera, the shutter opens and closes between 2 to 64 times per second.

With most cameras the shutter consists in principle of a circular metal disk out of which one section has been cut away. The angle of the cutaway is normally 180 degrees. The shutter rotates in front of the film gate aperture, creating an opening and closing action. They are also called rotating or revolving shutters.

Some cameras (Beaulieu) work with a shutter which consists of a rectangular metal plate which moves up and down in front of the opening.

Most cameras are equipped with a fixed opening shutter, while some have a variable shutter.

This last type consists of two identical semicircles. Normally each lies upon the other, but since one of them can be moved, the angle of the opening, i.e. the size of the cut-away section can be varied. The shutter not only guarantees that light reaches the film only when one frame is held still in the gate, but also influences with the size of its opening the amount of light striking the film. Therefore exposure time is dependent on the frames per second and the angle of the opening of the shutter.

$$\text{exposure time} = \frac{\text{shutter angle}}{360^{\circ} \times \text{f.p.s.}}$$

In a photographic camera the amount of light reaching the film can be adjusted by changing the lens aperture. In the case of a film camera, exposure time, first of all, is set for each individual frame by the running speed. If the running speed is changed from the normal 24 or 25 f.p.s. then the exposure time is affected.

The other factor which governs exposure time in a film camera is the angle of the opening of the shutter.

In the case of very bright light, the light meter often indicates a lens aperture of 32 when filming with b/w stocks. This f-number does not exist on narrow-gauge film camera lenses. One possibility of lowering the light level would be to use a neutral density filter, which would absorb the light two to four f-stops numbers. This effect is much easier to achieve by adjusting the shutter. If in a scene of deep contrast between light and dark areas, one of them would be more or less badly exposed if the camera pans over the scene. Here again the variable shutter can be used. This can be achieved by varying the shutter opening as the camera is panned over the scene from light to dark or vice versa. A variable shutter also allows the use of a wider lens aperture. This may be desirable to reduce the depth of field and so render only the important part of the picture in sharp focus.

The faster a subject moves while being filmed, e.g. a racing car, the more blurred it will appear. This can be reduced if exposure time is shorter.

Therefore, to film a fast moving object it is better to use a variable shutter. A variable shutter also allows fades and dissolves to be effected in the camera.

For a *fade-in*, the shutter is closed at the beginning and is gradually opened to the desired angle while filming. So the image emerges gradually out of total darkness to its normal light intensity. The reverse operation is a *fade-out*, where the image disappears in darkness while the shutter is gradually closed during filming.

Technically, a *dissolve* is the superimposition of a fade-out and a fade-in on the same strip of film. One scene gradually disappears while the next emerges. The first scene is filmed ending in a fade-out while the shutter is totally closed. The exact length to be rewound is read on the frame counter or counted in seconds. Then the next scene is filmed on the rewound part of the filmstrip as a fade-in. The fade-out and the fade-in must be of exactly the same length; they must start and end on the same picture frame. Since the accuracy in timing for both effects is difficult to achieve, dissolves for professional films are done in the lab, as are generally normal fade-ins and -outs.

The next important component of a film camera is the *viewfinder*.

Viewfinders are of two kinds: reflex and non-reflex. With a reflex viewfinder the image seen is exactly that being recorded on the film: the image is passed through the lens and by mirror or beam splitting methods is presented on the ground-glass screen of the viewer. This system has many advantages: critical focussing, precise framing and inspection of the depth of field are made easy. The presentation of the image on the ground-glass screen can considerably help the cameraman to visualize the final projected image.

Some cameras, for example the Arriflex 16 BL, do not only show the space of the frame in the reflex viewfinder, but also parts of its surroundings, so that objects outside the picture actually filmed can be seen through the viewfinder. This not only simplifies framing but also helps camera movements. In a pan the camera operator can see the objects before they are actually in the frame area. Many cameras, however, have viewfinders that operate by offering an approximation to the lens framing and are located on the side or the top of the camera. Used and adjusted properly, these viewfinders can give quite satisfactory results.

In whatever type of viewfinder that is used, marks are made on the inside to indicate the exact framing area. The standard markings for most 16 mm cameras are 16 mm frame area and television safe action area. In 35 mm cameras the viewfinders are marked with the frame area indicated in aspect ratios. By aspect ratio it is meant the ratio of the height of the frame to the width. The most common are the Cinemascope, 1.66:1; 1.85:1 and television. Because it can be confusing to inscribe all these markings on a single ground-glass, individual ground-glasses are supplied for each marking.

The lens is the most important element of the camera. It focusses the image on to the film. It is an important element to determine what area is seen in the shot and produces images of maximum sharpness. Lenses are of several types with special characteristics. Since these characteristics have considerable effect on the image produced, lenses will be discussed in a seperate chapter.

Various types of movie cameras available may have several other features; though few cameras have them all.

A lens turret, which accepts two or three lenses and enables them to be rotated in front of the shutter, facilitating a rapid change of lens without removing them from the camera, can be found on some 16 mm cameras.

A matte box - usually a bellows type attached to the front of the camera, with slots to hold filters, mattes (masks) etc., is used most frequently with reflex cameras, since alignment of the camera through non-reflex viewfinders can be difficult if a matte box is attached.

On cameras required for live sound filming, a blimp, a sound proof cover is placed over the camera to prevent the sound of the camera motor from being picked up by the microphone. Some cameras, such as the Arriflex, are self-blimped and an additional cover is not required.

Many cameras are provided with a film magazine which is mounted on top of the camera. The advantage is that magazines, already loaded with film can be quickly attached to the camera. Several sizes are available to accommodate various lengths of film.

Frame counters are often featured in addition to the regular footage counters, permitting precise measurement of film shot, essential when fades and dissolves have to be produced in the camera.

Devices for producing automatic fades are available on cameras with variable shutters (for instance, the RX fader in the Bolex). Filter slots may be built into the camera body, avoiding the need to attach a separate filter to each lens.

Extension tubes will enable extreme close-up work to be carried out.

Tachometers provide the means of checking the motor speed.

CAMERA SUPPORT

For the greater part of filming the camera is mounted on some form of support, which not only takes the weight of the camera, but also enables various types of camera movements. However, the camera may be held in the hand when necessary. The most common support is the tripod.

The use of a good tripod is essential. Tripods vary enormously in design.

The most important attribute of a tripod is that it should be firm to support the camera and to enable smooth movements. The standard tripod is usually about 3 to 4 ft. high when its legs are in closed position. It may be raised to perhaps 6 or 7 ft. when the legs are extended. Many tripods, whatever the length of their legs, will require a "spreader" (or "spider") - three slotted strips of metal or wood joined at the centre, to prevent the legs of the tripod from slipping apart when placed on a slippery surface.

The most important part of the tripod is the head, on which the camera is directly mounted. A good head should be provided with both a levelling device - preferably incorporating a spirit level, so that the camera can be set absolutely level without the tripod needing to be continually adjusted - and a "fluid action", in which the movements are made against the resistance from a viscous fluid held inside the head mechanism. This ensures that all movements will be perfectly smooth. Other tripods use a friction device to permit smooth movements.

For low camera angles a shorter version of the standard legs are available, commonly called, "baby legs". They may range from a few inches to a couple of feet. A "hi-hat" (or "top-hat") is a mount that rests directly on the floor, and enables extremely low angles to be taken. A "hi-hat" can also be placed on a table or other surface to make a camera support in places where a tripod could not be erected.

There are other camera supports for use when there is no time or space to set up a proper tripod and for aiding hand-held camera work. "Shoulder-pods" or body harnesses are virtually indispensable for hand-holding the heavier 16 mm cameras like the Arriflex or the Eclair. With lighter cameras, a monopod - a single leg support - or a pistol-grip can be useful. Other camera supports have special applications and can be used in various situations, e.g., a camera mount for filming from helicopter and fixed wing aircraft, mobile camera platforms and cranes.

The newest innovation, the "steadycam", where the camera is mounted on a spring-loaded device which is attached to the harness wound around the body of the operator. This enables the camera to float free from all body movements allowing smooth camera movements and complete mobility.

Under all conditions the maximum support available should be given to the camera while shooting. See also the chapter on camera movements.

CAMERA MAINTENANCE

Whichever camera is used, it is important that the camera operator be fully acquainted with it. Every camera has some features that are standard to all cameras, and some features that are peculiar to the particular mode. The cameraman must be sure before he starts filming that he is fully conversant with every detail of his tool. He should be so familiar with his camera that he can perform most of the operations and adjustments necessary, without having to remove his eye from the viewfinder.

The operator should establish a pattern of working and follow it always. There are a number of things to be remembered constantly and checked while filming, and the only sure way not to forget one or more of these is to establish a routine which includes them all and stick to it.

A basic camera drill, such as focus-aperture-motor (FAM) will ensure that, provided initial checks have been carried out, the intended pictures are recorded every time. If the focus is correctly adjusted, the exposure reasonably accurately calculated and set, and the motor has sufficient drive to complete the shot, the cameraman can be certain that what he shoots will be satisfactorily recorded on the film. Many of the rules of the camera operation are logical extensions of the mechanical workings of the camera. A thorough understanding of the camera leads to good camera maintenance, and an early awareness of any irregularity. The importance of good camera maintenance cannot be too heavily stressed. To ignore signs of fall-off in performance, or of faulty mechanical operation can easily lead to the wastage of hundreds of feet of possibly irreplaceable film.

CLEANING AND LOADING

Camera loading systems vary according to the type of camera - automatic or hand-threading, spool, cassette or magazine, daylight or darkroom loading - and the instructions in the camera's handbook must be exactly followed.

Whatever the loading system, whatever the camera, the inside of the film chamber and the intermittent movement mechanism must be thoroughly cleaned.

A blower brush, and, if necessary, a piece of soft wood, such as a toothpick, will be needed; they should be included in the camera kit, and should be on the camera checklist.

The camera interior must be cleaned between every loading. Emulsion particles are scraped off the film as it passes through the gate and transport mechanism. Even the quantity of emulsion that collects during the shooting of 100 ft. of film can lodge in the gate, and is sufficient to show up as a large black mark on the film when it is processed.

When the camera is loaded, check that the film is running correctly through the transport mechanism and gate before replacing the door of the camera; check that the back-plate is seated correctly and firmly secured to the camera. If the camera is magazine-loading, check that the magazine is properly seated and secured, and that the light-traps are perfect. All these operations must be done in subdued light - edge fogging does occur if light conditions are not suitable, particularly when 100 ft. daylight loading spools are used.

Once the camera is loaded, secure it on its tripod and check that the motor is fully wound, if clockwork, or connected correctly to fully charged batteries, if electric. Set footage and frame counters to zero (or to the pre-zero mark, if there is one) and run off the amount of film - usually five or six feet - provided on the front of the roll as integral leader until the appropriate zero mark shows in the footage indicator.

The running speed of the motor can be checked at the same time, especially with cameras fitted with variable speed motors where the running speed may be much too high. Next, remove the lens caps, and open the variable shutter, if fitted, to the required angle of opening. If the viewfinder is of a non-reflex type, check that it is adjusted for the focal length of the lens in use, and that any parallax error is compensated for. Ensure that the required lens is in taking position, and that any filter required is attached to the lens, or placed in its slot or holder. Minor adjustments, and those peculiar to certain cameras, can now be carried out. These will vary considerably, but everything should be carefully checked.

THE LENS AND ITS FUNCTIONS

As we have seen in the chapter on the nature of light, light rays (wave lengths) are bent when they travel from one transparent medium to another (for example, from air to a prism).

Lenses made out of glass or other transparent material can thus focus (bundle) or diverge (disperse) light rays falling through them. Whether a lens focusses light or diverges it, depends on its shape. A positive lens which produces a real image on a screen through focussing the light is thicker at the centre than at the edges (convex lens). A negative lens, which cannot by itself produce an image which the light rays appear to diverge, is thicker at the edges than at the centre (concave lens).

If there is no lens to focus the light rays coming from the subject, no image will be produced, because all rays from all points will strike all parts of the film. The convex lens bends the rays from each single point so that they converge on the focus plane a certain distance behind it. The image created by the lens is reversed right to left and top to bottom. Single lenses are affected by errors due to physical causes which prevent truly accurate convergence of the light rays. Therefore, today most lenses used in film-making are composed of various lenses of different shapes, i.e. of many elements to correct aberrations.

FOCAL LENGTH AND ANGULAR FIELD

Lenses are generally classified according to their focal length. In principle, the focal length is the distance from the centre of the lens to the point at which a sharply focussed image of an object placed at an infinite distance is formed.

For example, if the distance from a magnifying lens to its focussed image of the sun is three inches, the lens has the focal length of three inches. Because most lenses are made of many elements, the centre of the complex lens is not as easily determined. Usually the optical centre is located roughly midway between the front and rear elements; its principal point can be thought of as equivalent to the geometric centre of the simple lens. Focal length is defined in terms of distance from the principal point to the image point. It is measured in millimeters.

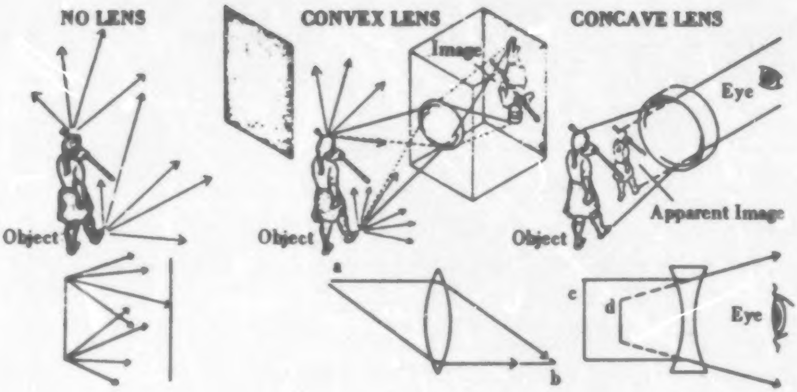
The focal length of the lens is the quality that determines the size of the image. The linear dimensions of the image will be magnified in direct proportion to the focal length. Provided the camera distance remains constant, a shot with a 50 mm lens will record the subject twice as high as if shot with a 25 mm lens; or, shooting a subject with a 50 mm lens at ten feet results in the same size image on the film as shooting the same subject with a 25 mm lens at five feet. Since the focal length determines the size of the image, it also sets the angular field, i.e. the image area. It is easy to imagine that, since the space of a picture frame normally remains constant, a lens which magnifies the subject will show less of its surroundings, whereas a lens which registers a person or an object in small size, will put more of the things around it on the frame.

For example, a 12.5 mm lens in 16 mm work will have twice the vertical and horizontal angle of view of a 25 mm lens. Therefore: the shorter the focal length, the larger the angular field; the longer the focal length, the narrower the angular field.

With a wide-angle lens of $f = 10$ mm, the angular field will be 55°; with a standard lens of $f = 25$ mm, the angular field will be 8°. The image area of a respective lens can be easily calculated by putting into relation the distance of the camera to the subject, the focal length of the lens and the angular field.

The most basic use of lenses of different focal length is to vary the size and the magnification of the image.

A cameraman has three basic types of lenses available to him, although the differences between those types are relative rather than absolute.



LENSES. If there is no lens to focus the rays of light coming from the subject, no image will be produced (left): all rays from all points will strike all parts of the photosensitive plate or film. The convex lens (centre) bends the rays from each single point so that they converge on the "focus plane" a certain distance behind it. The image created is reversed right to left and top to bottom. (A transparent negative can then be turned to create the proper left-right orientation in the print.) A pinhole, if it is small enough, will act like a convex lens to give a rough focus. This is the elementary principle which led to the invention of the Camera Obscura. The concave lens (right) causes the rays to diverge in such a way that an observer perceives an "apparent," or "virtual," image which seems smaller than the actual object. The diagrams below the drawings schematically indicate the optical effects of each.

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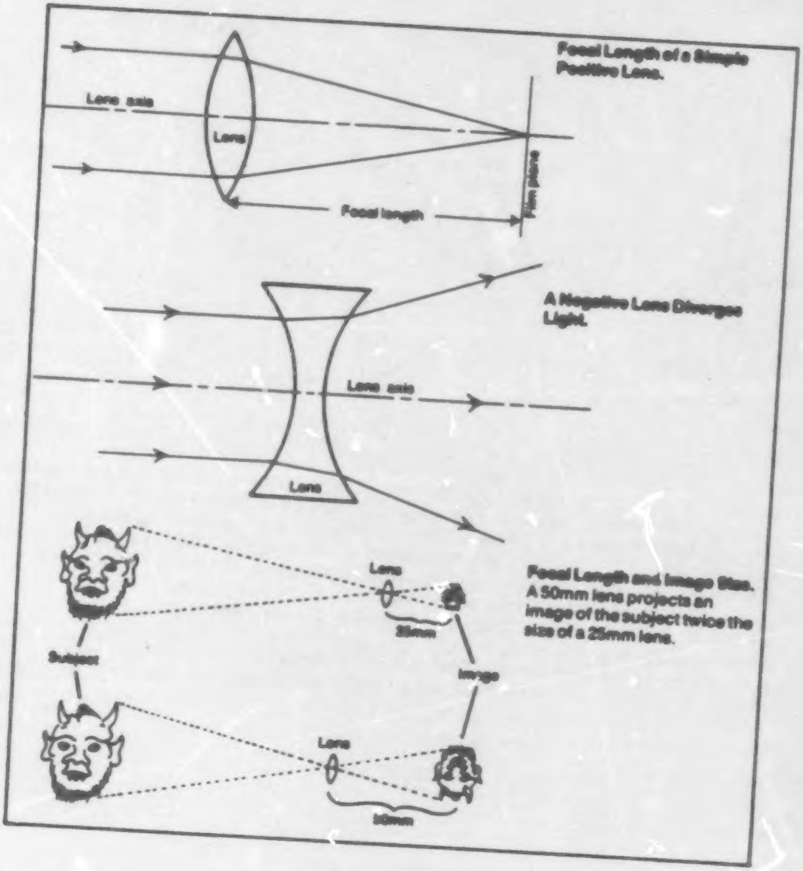

Lens axis
Lens
Focal length
Film plane
Lens axis
Lens
Lens
25mm
Subject
Image
Lens
50mm

Focal Length of a Simple Positive Lens.

A Negative Lens Diverges Light.

Focal Length and Image Size. A 50mm lens projects an image of the subject twice the size of a 25mm lens.

THE NORMAL (STANDARD) LENS

It is always difficult to define what is normal. For many cameramen the standard lens is not the one they normally and mostly use. The classification of normal lenses has come about mainly out of manufacturing standards. For 35 mm cameras the standard lens has a focal length between 35 and 50 mm. For 16 mm cameras, lenses of about 25 or 26 mm are classified as normal. This means that in principle lenses of the focal length of roughly double the length of the diagonal of the picture frame are rated as normal ones.

Generally, a normal lens produces an image which most closely reproduces the way the human eye perceives perspective. It hardly distorts linear perception and depicts the relation of foreground, middle-ground and background in a normal way.

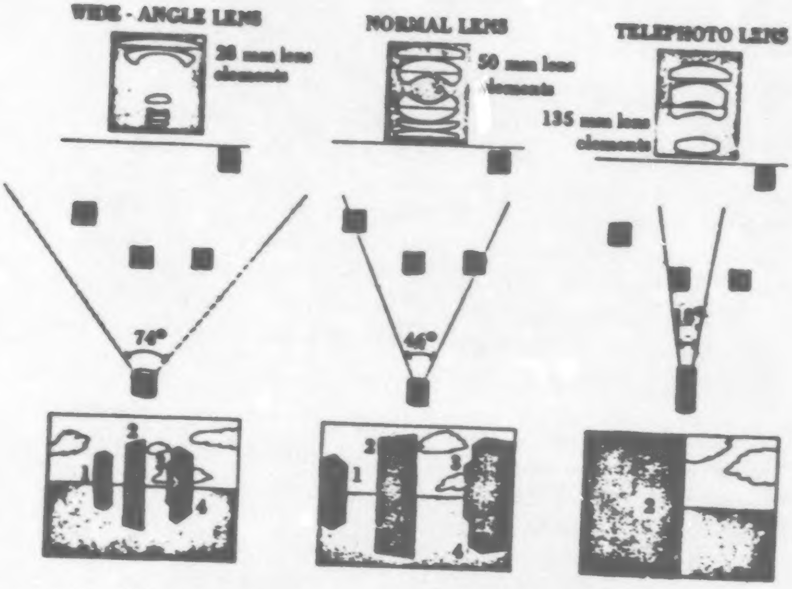
THE WIDE-ANGLE LENS

Generally for 35 mm film, any lens shorter than 35 mm focal length is considered a wide-angle lens. In 16 mm work any lens shorter than 16 mm is classified as wide-angle.

As the name indicates, a wide-angle lens photographs a wide-angle of view. It depicts the subject in a relatively smaller size and therefore covers more of its surroundings. A cameraman finding himself in a cramped location would use a wide-angle lens in order to register as much of the image area as possible. However, the wide-angle lens also has the effect of greatly emphasizing our sense of depth perception and often of distorting linear perception.

THE TELEPHOTO LENS

Normally, for 35 mm film any lens longer than 60 mm is considered as telephoto lens. For 16 mm work any lens longer than 50 mm is rated as telephoto.


WIDE - ANGLE LENS
28 mm lens elements
NORMAL LENS
50 mm lens elements
TELEPHOTO LENS
135 mm lens elements
74°
46°
18°
1
2
3
4

WIDE-ANGLE, "NORMAL," AND TELEPHOTO LENSES. Nearly all modern photographic lenses are composed of sets of elements, such as those which are schematized at the top of this Figure. The 28 mm, 50 mm and 135 mm lenses are common wide-angle, "normal," and "telephoto" lenses in 35 mm photography, whether motion picture or still. Each of the three lenses diagrammed in the middle of the Figure is seeing the same arrangement of four columns from the same distance and perspective. The frames at the bottom are exact visualizations of the various images of the scene each lens produces. The wide-angle lens image appears to be taken from a greater distance; the telephoto image is greatly magnified. Notice the slight linear distortion in the wide-angle image and the "flat" quality of the telephoto image. In 35 mm photography, the 50mm lens is considered "normal" because it best approximates the way the naked eye perceives a scene.

The most obvious use of telephoto or long lens is that it acts like a telescope and magnifies distant object, or else, that it shows only a portion of a comparatively near subject. Compared with the standard lens, a lens of 50 mm focal length in 16 mm work will enlarge the subject twice.

Although the long lens does not distort linear perception, it does have the sometimes useful effect of suppressing depth perception.

THE ZOOM LENS

One can call a zoom lens a combination of all the three types of lenses already mentioned. It has a variable focal length and is therefore capable of continuously varying the magnification of the image or else to change the image area covered in a shot while shooting.

The continuous change in focal length is possible because in a zoom lens its various elements are movable along their optical axis. Normal zoom lenses may range from 10 - 100 mm focal length.

Most important for design purposes and cost of the lens, is the zoom ratio, and the minimum rather than the maximum focal length. Changing a short focal length a few millimeters, more heavily influences the zoom ratio than changing the high end the same amount. If a lens zooms from a focal length of 8 - 64 mm, it has a zoom ratio of 8:1. If we change the specifications of the short focal length by just one millimeter to 7:64 mm the ratio is now about 9:1.

With a zoom lens the film-maker is able to move in close to an important portion of the image, or to zoom away and show more area. This capability permits the zoom shot to look like tracking shot. When, for example,moving in with a zoom shot, the image is magnified and the angular field becomes narrower the viewer gets the impression that the camera travels towards the subject. But since the camera remains in a fixed position, only the focal length of the lens is changed, depth perception changes from exaggerated to suppressed and the relation between foreground, middle-ground and background remains constant as does perspective.This is not so in a real tracking shot.

In recent years the quality of zoom lenses has improved so much that they are comparable to the best fixed focal lenses. Therefore a zoom lens can be considered as a lens set and the different focal length can be used individually. So various focal lengths are available to the cameraman without need to change the lens or to turn the turret between different shots. The disadvantage of the zoom lens is its size and its relatively heavy weight.

A zoom lens for 16 mm work does not allow filming of a subject at a distance shorter than 1.5 m (6 ft.). Supplementary (accessory) lenses for shorter distances up to 0.65 m (little bit more than two feet), are available.

While a zoom lens changes its magnification, the f-stop should remain constant as should the focus. If there is a shift in f-stop, the exposure will change while zooming. If there is a shift in the focussed distance, it will be impossible to keep the subject sharp while zooming. Most modern designs maintain focus and f-stop, but in any case not only exposure but also distance should be measured (not guessed) and set before shooting.

FISHEYE OR VERY WIDE LENSES

These lenses are rarely used in ordinary film work. The fisheye lens gets its name from the fact that it resembles the eye of a fish. Its very large front section precedes its image forming section. Fisheye lenses can cover an amazingly great angular field. Some of them are actually able to see behind themselves.

LENS CHARACTERISTICS

LENS SPEED

Of the three ways to vary the amount of light that enters the camera and strikes the film; filters, frames per second/shutter opening, aperture setting - only the last one concerns us here.

The term speed is often used to express the light gathering facility or light gathering power of a lens. A fast lens makes available a lot of light for exposure. A slow lens makes relatively little light available.

The light gathering power of a lens is easily imagined if one conceives the camera as being a closed room with a circular window. The light rays will fall through the window opening, and strike the wall opposite it. The wall opposite the window will receive more light, if the window opening is large and its distance to the wall is short.

In our case, the window is the lens, the wall opposite it represents the film and, since normally the focal length of the lens equals the distance between lens and film, the length of the room is the focal length of the lens.

The amount of light striking the film therefore depends on the opening of the lens and the focal length of the lens.

The opening of the lens can be controlled or altered. As the pupils of the human eye increase or decrease in diameter with varying lighting conditions, the effective diameter of the lens can be varied to control the amount of light reaching the film. Most lenses accomplish this with an iris diaphragm. The diaphragm is made of movable elements, which form a circular opening that can be altered to different sizes, i.e., its diameter can be changed.

Thus the transmitting power of a lens is characterised by the ratio of the diameter of the effective aperture to the focal length. This is called the lens aperture ratio or relative aperture of the lens. For example, if a camera lens has an aperture of 25 mm in diameter and a focal length of 50 mm, its aperture ratio is 25:50 = 1:2, where the figure 2 is the so-called f-number (often designated as f/2). If the aperture is reduced to 12.5 mm, by altering the aperture setting (i.e. by closing the diaphragm or stop), then the ratio will become 12.5:50 = 1:4, i.e. f/4.

The aperture with half the diameter has only a quarter of the area of the initial aperture and therefore admits only a quarter of the initial amount of light into the camera. So, moving from numerically low values for f to high values decreases the light transmitted by the lens. Moving from the high to the low values of f is an increase in the amount of light passing through the lens. The larger the f-number, the less light the lens transmits.

The f-numbers (aperture settings) of a camera lens are usually so arranged that each next higher f-number corresponds to a reduction of about one-half in the light transmitting power of the lens, e.g.:

aperture (f-number)	1.4	2	2.8	4	5.6	8	11	16
relative brightness	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{128}$

Hence a lens with f/2.8 is sixteen times "faster" than one with f/11. If, for instance, an exposure time of $\frac{1}{500}$ sec. is sufficient at f/2.8, it will be necessary to give sixteen times as long an exposure at f/11, i.e. about $\frac{1}{30}$ sec.

For a telephoto lens with a focal length of, say, 100 mm, to have the same speed as a normal lens of 50 mm focal length, it will have to have twice the diameter of the lens. This larger lens will transmit four times as much light, but since the image formed on the film is twice as large linearly, i.e. has four times the area of the image formed by the normal lens, the brightness remains the same.

The same f-numbers, on any two lenses of any manufacturer, design or focal length, theoretically have the same speed. A 10 mm lens with a maximum aperture of f/1.8, set for f/4, will transmit the same amount of light as a 150 mm lens, maximum aperture f/3.3, set for f/4. The f-stop is usually selected by moving a ring on the lens mount. Nearly all lenses made for many years have these markings in the following sequence: 1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45, 64. The lens may not have all these markings, especially those at either end of the scale.

The maximum openings of many lenses for motion picture use are comparatively high, especially for short and intermediate focal length, say, from 10 to 50 mm for 16 mm work. Openings are in the order of f/0.95 to f/2.

The most obvious effect of changing the f-stop is the change in the light level reaching the film, i.e. to alter exposure to suit light condition.

Since the f-number is defined as being the ratio of the diameter of the effective aperture in relation to the focal length of the lens, it does not take into account light losses caused by reflection of the glass surface of the different lens elements. In complex lenses, this can amount to one stop or more. Lenses used for professional motion picture work are therefore often calibrated with T (for transmission) stops. The T-stop is actually the effective f-stop, since it takes into consideration these light losses in the lens system. Anti-reflection coatings for most lenses have reduced the need for T-stops, by making the difference through light loss negligible. The introduction of zoom lenses with many elements, i.e. many glass surfaces, makes the T-stop system more interesting.

SHARPNESS AND RESOLUTION (DEFINITION)

The most recent attempt to evaluate definition in photographic system has been the introduction of the modulation-transfer curves. Prior to the introduction of modulation-transfer functions, lenses were tested by exposing high resolution film to a target of ruled lines. Such a test is called a resolution test, determining the resolving power of a lens. In order to give sharp images for large screen projection, the 16 mm lens should be able to resolve about one hundred lines per millimeter. A lens produces sharp pictures if it has sufficient resolving power but can also form a suitably contrasting image.

But the sharpness of the image projected on screen is a function of many other factors beside the lens: quality of filmstock, use of filters, camera shake, film registration, processing and printing and the quality of the projector and the surface of the screen.

DEPTH OF FIELD

When a film-maker focusses his lens on a subject at a certain distance, not only this subject will be sharp, but there will be a range of acceptably sharp focus in front of and behind this particular subject. Just how much is in focus, or what may be the extent of acceptable focus, is referred to as depth of field. Depth of field depends on the focal length of the lens, the opening of the iris diaphragm, i.e., the aperture of the lens at this particular shot, and the focussed distance. All three factors together can assist in increasing the depth of field and, conversely, all three can lessen the range of distances that will appear to be in focus. So, for example, with an aperture of f/4 and a focussed distance of 3.00 m, the depth of field of a lens of 25 mm focal length reaches from 1 90 m to 7.40 m. A lens of, for instance, 100 mm focal length will give a depth of field from 2.90 m to 3.10 m at the same f/stop and distance. In practical work, the following rules concerning depth of field are the most essential ones:

DEPTH AND F-STOPS

For a lens of a given focal length, stopping down the lens will increase the depth of field. The smaller the opening of the iris diaphragm, the greater the range of focus. For example, a 25 mm lens for 16 mm film work, focussed at 10 feet at f/2 will have a depth of field of from 8 to 14 ft. Stopped down to f/5.6, the depth of field becomes 6 to 32 ft., and at f/22, 3 ft. to infinity. The reverse is also true: the bigger the opening of the diaphragm, the narrower the depth of field.

DEPTH AND DISTANCE

For a particular f-stop and focal length, the closer the film-maker focusses his lens, the less the depth of field.

A 25 mm lens for 16 mm film-making, assuming an f-stop of f/5.6 focussed at 2 ft. has a depth of field of from 1 ft. 9 in. to 2 ft. 4 in. The same f-stop and focal length, now focussed at ten ft. yield a depth of field of 6 to 32 ft. Depth of field tends to diminish rapidly as the lens is focussed close on objects close to the camera.

DEPTH AND FOCAL LENGTH

As the examples have already indicated, the depth of field of lenses varies according to their focal length. The shorter the lens, the bigger the depth of field, the longer the lens, the narrower the depth of field. A wide-angle lens therefore will show more area in front and behind the focussed subject in relative sharpness, than a telephoto lens, where the range is very small.

DEPTH OF FIELD SCALE

To know the depth of field at a given distance with a particular focal length, the film-maker can consult depth of field tables. These tables are calculated to the nearest inch or fraction of a meter.

The next method for determining depth of field is very convenient but is limited to lenses of fixed focal length. An indicator is engraved on the lens mount, and the depth of field may be read off this scale once the lens is focussed. There are several types of scales in use, but all follow the same general principle.

CAMERA GUIDE

Arriflex 16 St

A camera which features a mirror shutter reflex system with an angular opening of 180°. It uses a single pull down 'claw' and single registration pin to transport the film in the camera. Arriflex cameras have an outstanding reputation for registration and superiority of construction. The viewfinder is parralaxfree and enables through the lens viewing and focussing. The mirror shutter rotates at 45° angle and passes the image through to the viewfinder, erect and correct from left to right. The lens turret provides for three lenses, and several focal lengths can be used starting at 5.7 mm. Following focus is accomplished by grasping 'wings' on the lenses. The variable speed camera motor will drive film from 0 to 50 f.p.s. The motor is interchangeable and special motors for sync. sound and animation are available. It can also be exchanged for a constant speed motor of 24 or 25 f.p.s. with pilotone generator. The camera contains a single-frame counter and one which counts in meters or feet. It has provision for 100 ft. loads and will also accept a magazine which can hold up to 400 ft.

Arriflex 16 M

A camera which also uses a reflex viewfinder and the same motor as the Arri St. It uses magazines for 200 ft., 400 ft., or 1200 ft. of filmstock. The magazines are easy to change and can be run forward or reverse. Pilotone and automatic sync. start marker are standard. The camera runs rather quietly. For live sound filming both the 16 St and the 16 M can be equipped with a blimp cover. Except for the magazines, all accessories for the 16 St can be used for the 16 M.

Arriflex 16 Bl

In principle this camera is similar to the 16 M model, but it was especially designed for lip-sync, sound recording and is fully self-blimped. All noise producing or conducting parts like the films transport system, the motor, the lenses, the reflex viewfinder and the magazines are insulated. Special blimped zoom lenses are necessary to maintain the required low noise level. The camera will shoot single or double system sound. A special module, easily installed, will convert the camera to single system sound-on-film recording on magnetic striped film. The noise level of this camera is approximately 31 db at 3 feet.

Arriflex 16 SR

This is one of the smalles 16 mm cameras for professional film. Its weight is approx. 10 pounds, its length 11¼'', width 3¼'' and its height is 9''. It uses quick change magazines of the coaxial type for 200 and 400 ft rolls. It has a fast 12 x magnification viewfinder, which can be rotated in 3 axes with complete image position alignment. It uses a cam driven claw and registration pin to transport the film. The special motor works with direct current, is crystal controlled, runs at 24 or 25 f.p.s. and can be placed in a slave mode. Extensive accessories are available like pilotone, variable speed, a phase shifter to film from monitors, etc. The camera has an automatic diaphragm, is self-blimped and accepts the new time coding system.

Bach Auricon Pro Special - Super 1200

An extremely quiet running sound camera for 16 mm. It can record optical sound or magnetic sound in the single system mode. It is also used for double system. The Pro 600 Special is available with and without lens turret with a standard C-mount for the lens(es) of various focal lengths as well as zoom. The camera is equipped with thermostatic heating and synchronous motor operating at 110 volt A.C. power supply at 24 or 25 f.p.s. The Pro 600 Special uses magazines with a capacity of 400 ft. it is reasonably light weight, weighing 24 lbs. with loaded magazine and lens.

Two new models are in preparation, the CM 80 for A.C. power supply and the CM 78 run by batteries. With the new models the viewfinder has been changed, the threading system has been simplified and pilotone system has been added. The new models will use magazines of up to 1200 ft. Their weight will be approx. 13¼ lbs. without magazine and lens.

Beaulieu R 16 Electronic

A very lightweight (3½ lbs. without lens) camera which takes 100 ft. spools and has provision for an additional magazine for 200 ft. spools. The camera has solid state electronically governed speeds from 2 to 64 f.p.s. and built-in tachometer to set the speeds accurately. The tachometer has a second scale which is used for accurate setting of the sound speeds of either 24 or 25 f.p.s. A single frame shaft accepts a compact syncpulse generator for double system lip-sync. filming. The viewfinder is a reflex one which presents the image on a ground-glass screen. The camera has an accurate through-the-lens light meter, adjusted by operating the diaphragm until the pointer in the finder is vertical. It has a circuit for fully automatic control of the iris diaphragm of the zoom lens. It has a turret for three C-mount lenses of between 10-150 mm. Lenses of longer focal length would need support because the turret is supported only at the center. It has an electric drive to rewind the total footage. It also features electric remote control and single frame control for animation.

Bell & Howell 70 DR

A very small lightweight 16 mm camera of rugged design and construction. It is suitable for TV news filming. It accepts C-mount lenses on a turret and is spring driven. 100 ft. daylight loading spools or 400 ft. external magazines are available.

Bolex H 16 RX

This camera is spring driven and one wind will run for 16½ ft. of film (28 sec. at 24 f.p.s.). This is long enough for most scenes, but it can give the operator a sort of nervours feeling. The camera has practically everything a camera could have, with the exception of a through-the-lens meter. It has a filter slot, fully closing variable shutter, film rewind, single frame release, automatic threading, frame counter and speeds from 12 to 64 f.p.s. The registration is very good. The reflex viewfinder works through a behind-the-lens beam splitter. The turret accepts three C-mounts lenses from 10 to 500 mm. It uses 100 ft. spools but can take an additional magazine with a capacity of 400 ft. Accessories include two kinds of electric-drive motors, one for filming at variable f.p.s., and another constant-speed motor for filming at 24 or 25 f.p.s. The latter has a sync-pulse generator which may be used for lip sync. shooting.

Cinema Products 16 R

A lightweight, fairly quiet and portable camera of recent design. The intermittent movement is similar to the Auricon, utilizing a single pull down claw of special hardened steel for quiet running and long life reliability. The shutter is fixed at 173° opening and is of the mirror reflex type. The viewfinder uses a high gain type ground-glass screen made of film optics and permits viewing and easy focussing in low light levels. Its special features include information on various states of the camera operation, e.g. out of sync. warning light "S", weak batteries "B", end of film "F", VU meter "VU". It also includes an exposure condition display which is coupled to a behind-the-lens meter. Exposure can be quickly adjusted during shooting.

The motor drive consists of a unique built-in highly efficient and small D.C. motor regulated by a crystal circuit, at either 24 or 25 f.p.s. Variable speeds can also be achieved.The camera runs from a 20 V.D.C. exchangeable battery which fits into the camera body, snap in and runs 3,200 ft. of film. There are no tracking cables as in other cameras. Heavy duty single lens turret enables positive looking of a variety of focal lengths and all the popular zoom lenses. The C.P. 16 accepts double compartment type magazines in 400 and 1200 ft. loads. The camera can be used in double system or single system filming. It features a plug-in magnetic recording head and built-in amplifier. It is also capable of using an auxilliary amplifier such as the Auricon type. The C.P. 16 is ideally suited for hand-held filming because of its light weight - a little over 15¼ lbs., and it features an operating handle permitting the camera to be mounted on the shoulder for long periods. A variety of other features are available and repairs can be done in the field, making it very popular with documentary film-makers. It is also available in non-reflex or studio-reflex versions.

Eclair 16 NPR (Noiseless, Portable, Reflex)

This camera was the first unblimped low noise reflex camera. It runs so quietly that its noise level is less than that of most other comparable blimped cameras; 29.5 db at 3 feet. The quietness of the mechanism is achieved through a new claw system and the fact that reflex mirror-variable shutter, motor, motor control and the frequency tuner for pilotone are situated on one axis. Only on two points movement is transferred to the transport mechanism and the magazine

The camera features a turret for two lenses. CA-1 and C-mount lenses of any focal length may be used without affecting the noise level. The camera rests upon the shoulder and can be held for long periods of time.

It uses quick change magazines of the coaxial type using a pre-threaded system. 100 ft., 200 ft., and 400 ft. rolls may be loaded. Several types of motor drives can be used and installed quickly and easily without tools. 12 V D.C. constant speed with pilot generator, crystal controlled with variable speed and 100 V A.C. motors are available. The double 360° swivelling viewfinder is extremely bright, showing areas in excess of film aperture and enables filming to be done in any convenient positon.

Eclair 16 ACL

This camera is the smalles 16 mm camera for professional use. Without lens its weight is a little less than 8 lbs.,with lens and 200 ft. roll its length is 10 3/4'',width 6'' and height 7''. It takes 16 mm filmstock with single or double perforation with A (emulsion facing out), or B (emulsion facing in) winding on 50 millimeter plastic cores or 100 and 200 ft. spools. A 400 ft. coaxial magazine is also available. The reflex viewfinder is fully hinged, has diopter adjustment and works with a pendulum mirror, operating at half camera speed. The fixed shutter has an opening of 175°. The camera has a filter slot for gelatine filters. The 12 V motor works with direct current, is crystal controlled and runs at 24 or 25 f.p.s. The noise level is comparable to the Eclair NPR. The camera accepts lenses in a variety of focal lengths and several mounts.

Eclair CM - 3 (16/35)

A unique camera capable of running 16 mm or 35 mm films, with several features similar to the Eclair NPR. It is not noiseless, and requires a special housing for sound filming.

Mitchell (16 mm Cameras)

An extremely fine engineered range of cameras for most professional purposes.

High cost, size and weight limit their use to studios. Three models are available for professional use including a high speed version. All cameras utilize the rack-over system of focussing and require a blimp for sound shooting. Fine craftsmanship is the hallmark of these cameras even though they are seldom used nowadays.

Mitchell cameras also come in portable versions, single or double system with the same degree of craftsmanship and excellence in manufacture and numerous excellent features. They are reflex types using a dual shutter arrangement permitting variable adjustments during shooting, and capable of accepting the widest range of lenses with superb quality and definition. A somewhat complex threading of film in the camera is compensated by a superbly designed and quiet running intermittent movement. A new super sophisticated hand-held model of new design has been introduced recently with the same standard of excellence for which Mitchell cameras are famous throughout the film industry.

FILTERS

There are so many possible uses for filters, that no general statement can be made about them, except that they control or change the exposed image.

Filters are available in gelatine or glass or gelatine cemented between two pieces of flat glass.

Gelatine filters are lacquered to resist abrasion, but they still can be damaged easily. They can be dusted off but it is difficult to remove fingerprints or grease from them. Since they are inexpensive, they should be replaced as soon as their quality becomes questionable.

Gelatine filters have to be cut to the appropriate size. This should be done by placing the gelatine between two clean and stiff pieces of paper while cutting it with a sharp scissors. To keep gelatine filters flat and firm they should be bordered with black photographic masking or mounted into frames. Humidity can cause gelatine filters to become opaque. Therefore, they must be stored in a dry place. Also, high temperature affect gelatine filters and those of the glass-gelatine sandwich type. Kodak Wratten filters, for example, should not be exposed to temperatures higher than 120° (50°C), and even this only for a short time.

Gelatine filters can be placed in front of the lens in the rear portion of a matte box, or between retaining rings mounted on the lens. Some cameras, like the Bolex H models, are equipped with a filter slot. One advantage of using gelatine filters in a filter slot or matte box arrangement is that the filter remains in position even when the lens is changed.

Glass filters should be handled as carefully as photographic lenses. Glass filters are placed in front of the lens. One type of glass filter comes fitted with a screw-in thread that matches the thread of the front section of the lens mount. Other types have their own matching device, ranging from bayonet to push-on type arrangements.

All filters, whether glass or gelatine, will change colour or fade in time. Since this deterioration is related to exposure to light, storing them in the dark will retard fading. Depending on the need, one or more filters can be used in one shot. Also combinations of glass and gelatine filters are possible. But, despite the fact that the surface of glass filters is flat and many of them are supplied with an anti-reflex coating, it can happen that scattered light or deficiencies of the glass surface may affect the sharpness of the shot, especially when working with large apertures or when using several glass filters at the same time. Therefore, gelatine filters are often preferable and in general the number of glass filters should be kept at a minimum.

Filter Factor

Since most filters absorb part of the light, working with them usually requires an increase in exposure. The filter factor indicates the number of times the aperture must be increased to transmit the equivalent amount of light. For example, a filter with the filter factor 2, will need twice the aperture, i.e. one stop more, than if no filter is used; a factor 4 filter will require two stops more, and an 8 factor three stops more - since the stops progress geometrically.

To calculate the necessary exposure one can also divide the ASA number of the filmstock by the filter factor and use the exposure meter accordingly. So a filmstock with 50 ASA and a medium yellow filter with a factor of 2, could be considered to have 25 ASA.

Manufacturers publish filter factors and technical data sheets containing the relevant information.

Filters for B/W Filmstocks

The major use for filters in b/w film-making is to control the tonal relationship of subjects. Sometimes the film-maker might want to emphasize aspects of the scene by darkening or lightening parts of the image. One some occasions, filters make the tone of the scene reproduce more naturally than the filmstock without filter would. A yellow filter, for example, will give a much better rendering of the sky in exteriors; by keeping out much of the intense blue light from the sky, it prevents overexposure in the sky area of the image and gives good detail in cloud formation. The guiding principle in the use of a coloured filter with b/w film (negative and reversal) is that the filter will render similar colours as lighter tones, and complementary colours as darker tones. So, for example, a green filter will lighten, and so emphasize green foliage, but darken red lipstick. B/w filters can be used for colour film as well where a special colour effect is needed and the effect they produce can be easily judged while looking through them at the subject to be filmed. In the following list of common filters and their effect on b/w film, the Kodak Wratten designation is given in parentheses. Other manufacturers use other designations:

Yellow (K2) is the most popular filter for b/w film. A yellow filter suppresses the transmission of blue-violet and will so help reproduce the colours of the subject more accurately in tones of black and white. The filter deepens blue sky, while leaving other colours in the scene essentially unaffected. The filter factor is 2.

Deep Yellow (G no. 15) filter produces even greater darkening of the sky. It is claimed that this filter helps penetrate haze so that detail in distant views will be recorded more clearly. Because it tends to change the values of lips and skin it should not be used for close-ups for faces which include a sky background. The G filter has a filter factor of 3.

Red (A no. 25) filter has a high factor, about 8. It will produce very dark dramatic skies. It can be used in conjunction with underexposure in a tempting to simulate night effects during the day. Greens, such as foliage, will be darkly rendered.

Green (XI). The use of this filter will result both in darkening of the sky, and a lightening of the tones of green subjects which will gain an astonishing degree of detail. It has a filter factor of 4.

There are many other filters which can control and correct b/w images. B, for example, is a deeper version of XI, with more striking effects and a filter factor of 8. Similarly, there is a wide variety of yellow, orange and red filters.

Colour Film Filters

There are several types of colour film filters. The most important thing to understand in the use of filters for colour film, is to remember that colour filmstock is balanced for specific colour temperatures, either for artificial or for daylight use. Daylight film is balanced for 5,800°K; film for artificial lighting is balanced for lighting sources of either 3,400°K or 3,200°K temperature.

It is common practice to use film for artificial lighting with filtration in daylight, but not vice versa. To eliminate the pronounced reddish cast which will show if daylight film is used without filter with artificial lighting, one has to use a blue filter which has a high filter factor. The orange filter, such as the Kodak Wratten no. 85 for artificial to daylight conversion, has a filter factor of only about 1.5 or 3/4-stops, whereas the blue daylight to artificial filter, such as Kodak Wratten no. 80 A has a factor of about 2 or 4-stops.

Film balanced for daylight should only be converted and used with artificial lighting in cases of emergency, because the filter requires 2-stop more light and good colour quality is not achieved.

Colour film for the professional motion picture industry is usually supplied balanced for 3,200°K (Tungsten illumination). For outdoor use it is filtered. Nearly all theatrical films are shot in this way.

To convert one type of film into another type, artificial to daylight, for example, Conversion Filters are used. As has already been mentioned in the chapter on filmstock, it is more often than not the case, that the balancing of the filmstock for artificial light and the colour temperature of the light sources at disposal do not match exactly. In these cases Light Balancing Filters are used. They are milder filters for slightly adjusting the film to the colour temperature of the prevailing light. Though they are mainly used with artificial lighting, they are useful with daylight film as well, for example, to adjust a daylight balanced film to the warmer and redder light in the early morning or towards sunset.

Filters can also be used to distort colurs for special purposes, for example, a light green or yellow filter may be used to exaggerate the greenness of foliage or to give a shot a more "lyrical" atmosphere. To add overall tones to a shot, light balancing or Colour Compensation Filters are used. Colour compensating filters are available, for example, in the Kodak Wratten series in six colours, yellow, magenta, cyan, red, green and blue, each having six densities. Depending on the density of the filter, exposure has to increase between a fraction of a stop to slightly over a stop. They may be used in combinations as well.

Colour compensation filters can also be used to overcome deficiencies of a light source which are outside the range of colour conversion or light balancing filters.

So, for example, a film balanced for daylight can be used with a "daylight" fluorescent lamp by using a colour compensation filter.

DECAMIRED FILTERS

Colour temperatures can be measured not only in degrees Kelvin but also in Mireds. This is a more convenient system to apply when using compensation filters because the same filter will produce the same numerical colour shift from one colour temperature to another anywhere along the scale, whereas the Kelvin measurements vary numerically. For instance, to shoot with a daylight film balanced for 5,800°K under lighting conditions of 6,500°K colour temperature, one has to use a pale amber filter. The same filter is needed to match filmstock balanced at 3,200°K and illumination of 3,400°K. The difference in degrees Kelvin in the first case is 700 and in the second 200. The Mired measurement makes the numbering the same for both cases.

Degrees Kelvin can be converted to Mireds by the formula:

$$M = \frac{1,000,000}{^{\circ}K}$$

Thus, 6,500°K equals 154 M, and 5,800°K equals 172 M giving a difference of 18 between both colour temperatures when measured in Mired. 3,400°K equals 294 M, and 3,200°K equals 312 M, also giving a difference of M 18. Note that the higher the Mired value, the lower the Kelvin value and vice versa.

To get lower numbers one normally uses not the Mired value but the decamired value which is 1/10 Mired: 10 Mired = 1 DM. The decamired system uses two sets of filters of varying densities of blue and red for "cooling" and "warming". Each filter is assigned a number according to its density. Common red filters are R3, R6, R12. Since they may be used in combination, for example, R 3, and R6 together produce the effect of R9, a few filters can produce a variety of densities. Blue filters are foten supplied in the same densities, namely, B3, B6, B12.

To calculate what filter to use with a particular combination of illumination and film type, one subtracts the decamired value of the illumination from the decamired value of the film. The resulting number equals the value of the correction filter. If the result is a positive number, one chooses red filters; if the resulting number is negative, blue ones. For example, a film balanced for 5,500°K (18 DM) used with an illumination of 3,200°K (31 DM) would need a filter of -13 (18 - 31 = 13), i.e. a blue filter of a value of about B12. Some colour temperature meters read directly in decamired values making any calculation unnecessary.

OTHER FILTERS

Two popular filters to use with colour film are the *Skylight* and the *Ultra-Violet Filters*. Their function is not related to the balancing of the film to a particular colour temperature, but to the fact that the uppermost layer of the colour film emulsion is sensitive not only to blue rays but to ultra-violet ones as well, i.e. that colour film records rays which are invisible to the human eye but will appear on the film as a bluish cast or in scenes which cover a longer distance as blue mist. Both filters require no exposure increase because they are nearly colourless. The Skylight filter is slightly pink, the UV filters are slightly yellow. The Skylight filter is often also useful to warm up shots made in the shade for it reduces the blue tinge. Both types of filters can be used for b/w film as well.

Neutral Density Filters which reduce the amount of light reaching the film may also be used with either colour or b/w filmstock. They are grey filters and have no effect on the colours of the scene. For this reason, while reducing the transmitted light, they will neither alter the tonal balance of colours recorded with b/w film, nor shift the colour balance of colours reproduced by colour film. Since these filters cut down the amount of light reaching the film to a determined extent, they have two main uses: Filtration with neutral density filter allows shooting in a situation when the film is too fast for the prevailing illumination.

For example, when shooting on very bright sunlit exteriors, or when using a converted film for artificial light outdoors. Filtration with a neutral density filter also allows a wider aperture than normal to be used, for instance, to decrease the depth of field of a lens. Neutral density filters are available in many densities, from the equivalent of one stop less exposure to heavy filters which cut light transmission several times.

Like neutral density filters the Polarizing Filter can be used with either b/w or colour filmstock without altering relative colours or tones. Polarizing filters have two major uses: To reduce or eliminate reflections from glossy surfaces like glass, or water and to darken the sky. Because reflections are suppressed, colour saturation of some subjects may be increased. In addition, some haze penetration may be achieved.

Waves of light travel in planes. Usually, light reflected or emitted from an object orients waves in planes at all angles with respect to each other. Such light is unpolarized. Polarized light is light whose waves are oriented in the same plane. A polarizing filter polarizes the light it transmits, i.e., it allows full transmission of light waves oriented in one plane only. Light attempting to pass through the filter at any other angle will be attenuated or totally extinguished. In practice, the filter is mounted in front of the lens, and by rotating it, its axis of polarization is achieved. If the plane of reflected light is at right angles to the axis of polarization of the filter, the reflection can be suppressed or eliminated. The filter is very successful for seeing the bottom of lakes, of pools of water, for example, since, if set at the correct angle, it will cancel out all reflections from the water surface. It can be used to suppress reflections from oil paintings, glossy photographs or many other objects. If a polarizing filter is used for an exterior scene it is often possible to deepen the colour of the sky, but this depends on the angle between sun, camera and sky. It's filter factor is about 2.5.

Controlling Tonality of the Sky for Black and White Films. (Eastman Kodak)

Material	WRATTEN Filter	Monochromatic Rendering of a Clear Blue Sky
Non-Color Sensitized	None	Lighter than correct
Orthochromatic	None	Lighter than correct
Panchromatic	None	Lighter than correct
Orthochromatic	K2 (No. 8)	Practically correct
Panchromatic	K2 (No. 8)	Practically correct
Panchromatic	G (No. 15)	Darker than correct
Panchromatic	A (No. 25)	Very dark
Panchromatic	F (No. 29)	Almost black
Infrared-Sensitive	A (No. 25)	Black

Light Balancing and Conversion Filters. To use this chart: if you're using film balanced for 3200° K and you plan to use it with a source close to 3200° K, you'll need a light balancing filter. For example, with a 2900° K source an 82B filter is recommended. Conversion filters produce greater control. For example, a film balanced for 5500° K that will be used indoors (3200° K), needs an 80A (3200° K to 5500° K). (Eastman Kodak)

	Filter Color	WRATTEN Number	Exposure Increase in Stops*	To obtain 3200 K from:	To obtain 3400 K from:
Light Balancing Filters	Bluish	82C + 82C	1 1/3	2490 K	2610 K
		82C + 82B	1 1/3	2570 K	2700 K
		82C + 82A	1	2650 K	2780 K
		82C + 82	1	2720 K	2870 K
		82C	2/3	2800 K	2950 K
		82B	2/3	2900 K	3060 K
		82A	1/3	3000 K	3180 K
		82	1/3	3100 K	3290 K
	No Filter Necessary			3200 K	3400 K
	Yellowish	81	1/3	3300 K	3510 K
		81A	1/3	3400 K	3630 K
		81B	1/3	3500 K	3740 K
		81C	1/3	3600 K	3850 K
		81D	2/3	3700 K	3970 K
		81EF	2/3	3850 K	4140 K
Conversion Filters	Blue	80A	2	3200 to 5500	
		80A	2	3400 to 5500	
		80B	1 2/3	3400 to 5500	
		80C	1	3800 to 5500	
		80D	1/3	4200 to 3200	
	Orange	85C	1/3	5500 to 3800	
		85	2/3	5500 to 3400	
		85B	2/3	5500 to 3200	

Color Compensating Filters.
(Eastman Kodak)

Peak Density	Yellow (Absorbs Blue)	Exposure Increase in Stops*	Magenta (Absorbs Green)	Exposure Increase in Stops*	Cyan (Absorbs Red)	Cyan-2 (Absorbs Red)	Exposure Increase in Stops*
.025	CC025Y	—	CC 025M	—	CC 025C	CC 025C-2	—
.05	CC 05Y	—	CC 05M	1/3	CC 05C	CC 05C-2	1/3
.10	CC 10Y	1/3	CC 10M	1/3	CC 10C	CC 10C-2	1/3
.20	CC 20Y	1/3	CC 20M	1/3	CC 20C	CC 20C-2	1/3
.30	CC 30Y	1/3	CC 30M	2/3	CC 30C	CC 30C-2	2/3
.40	CC 40Y	1/3	CC 40M	2/3	CC 40C	CC 40C-2	2/3
.50	CC 50Y	2/3	CC 50M	2/3	CC 50C	CC 50C-2	1

Peak Density	Red (Absorbs Blue and Green)	Exposure Increase in Stops*	Green (Absorbs Blue and Red)	Exposure Increase in Stops*	Blue (Absorbs Red and Green)	Exposure Increase in Stops*
.025	CC 025R	—	—	—	—	—
.05	CC 05R	1/3	CC 05G	1/3	CC 05B	1/3
.10	CC 10R	1/3	CC 10G	1/3	CC 10B	1/3
.20	CC 20R	1/3	CC 20G	1/3	CC 20B	2/3
.30	CC 30R	2/3	CC 30G	2/3	CC 30B	2/3
.40	CC 40R	2/3	CC 40G	2/3	CC 40B	1
.50	CC 50R	1	CC 50G	1	CC 50B	1 1/3

*These values are approximate. For critical work, they should be checked by practical test, especially if more than one filter is used.

Filters and Their Effects. (Eastman Kodak)

Subject	Effect Desired	Suggested Kodak Filter
Clouds against Blue Sky	Natural	K2
	Darkened	G
	Spectacular	A
Blue Sky as Background for Other Subjects	Almost Black	29 (F)
	Night Effect	A plus Pola-Screen, A or 29 (F) with infrared material
Marine Scenes when Sky Is Blue	Natural	K2
	Water Dark	G
	Natural	None or K2
Sunsets	Increased Brilliance	G or A
	Addition of Haze for Atmospheric Effects	47 (C5)
	Very SLIGHT Addition of Haze	No Filter
	Natural	K2
Distant Landscapes	Haze Reduction	G
	Greater Haze Reduction	A or 29 (F)
	Haze Elimination	A or 29 (F) with infrared material
Nearby Foliage	Natural	K2 or X1
	Light	58 (B), or G with orthochromatic
Outdoor Portraits against Sky	Natural	K2 or X1
Red, "Bronze," Orange, and Similar Colors	Lighter to Show Detail	A
Dark Blue, Purple, and	Lighter to Show Detail	None or 47 (C5)
"Foliage" Plants	Lighter to Show Detail	58 (B), or G with orthochromatic material
Architectural Stone, Wood, Fabrics, Sand,	Natural	K2
Snow, etc, when Sunlit and under Blue Sky	Enhanced Texture Rendering	G or A

DM Exposure Factors.
(Tiffen Optical)

R SERIES	F/STOP	B SERIES	F STOP
R 1 1/2	1/4	B 1 1/2	1
R 3	1/2	B 3	1 1/4
R 6	3/4	B 6	2
R 3 + R6 = R9	1	B 3 + B6 = B9	2 1/2
R 12	1 1/4	B 12	2 3/4
R 12 + R3 = R 15	1 1/2	B 12 + B3 = B 15	1/2
R 12 + R6 = R 18	1 3/4	B 12 + B6 = B 18	3/4

DM Film Types and Light Sources. (Tiffen Optical)

	Bluish daylight, open shade, overcast DM 14	Average Sunlight 9 a.m. to 3 p.m. DM 18	Late afternoon sunlight, reddish DM 20	Photofloods 3400° K DM 29	32[illegible] K Studio-Type Floods DM 31
Daylight Type DM 18	R3	NONE	B1 1/2	B6 & B1 1/2	B12
Type A and 3400K Tungsten DM 29	R12 & R3	R6, R3 and R1 1/2	R6 & R3	NONE	B1 1/2
Type B and 3200K Tungsten DM 31	R12, R3 and R1 1/2	R12	R3, R6 and R1 1/2	R1 1/2	NONE

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LIGHTING AND LIGHTING STYLES

Lighting is the most important element in cinematography. It is the task to which the cameraman gives his primary attention. He studies the characteristics of his filmstock so that he may predict what effect it will have in translating his scene on to the screen. He then manipulates the lights accordingly. Filters are an aid in modifying that translation. But it is lighting that shapes the reality in front of the lens, giving it depth or flatness, excitement or boredom, reality or artifiality. Cinematography attempts to create and sustain a mood captured on the screen: in this regard lighting is at the heart of cinematography.

A certain overall quantity of light is necessary to register the picture on film. However, the way in which the scene will be portrayed on the screen depends on the quality and distribution of the light. There are three distinct aspects to be considered: whether the source is "hard" or "soft", the angle of the "throw" (the path the light follows), and the colour of the light. Available light may be classified as two types - natural, which is daylight and artificial, which is illumination from electric light bulbs.

A light source can be defined as hard e.g. sunlight, spotlights, because the shadows cast are deep and sharply defined. A soft light creates weak shadows, that are less sharp. Floodlight and lights"bounced" off a diffusing reflecting surface will give soft light. Since lighting has so much to do with an individual style, the following is no more than a guide to the main points. Therefore the emphasis here will be on lighting hardware and technique, rather than advice on specific setups or the placement of the light sources. In theory, lights can be placed virtually everywhere, so long as they are out of the camera's field of view, and provide enough illumination for exposure. Lights should be placed to give the best effect, but the best effect is essentially a matter of aesthetics.

TYPES OF LAMPS

Most lighting instruments fall into three basic categories: Arc spotlights, incandescent spotlights, and open reflector lights (which have no lens). Arcs give an intense light and sharp shadows. They are powerful enough to illuminate large areas and are often used as fill lights outdoors in bright sun. They operate on D.C. current and require a special generator because of the large power consumption.

The second group contains the family of spotlights which uses a lens and which provides a hard light The Fresnol lens spotlights are most widely used, mainly as key, back, kicker and set lights, because they produce the hard light desirable for those functions. They are available in sizes from 50 watts to 10.000 watts and use either regular tungsten or halogen bulbs.

Open lights come in many variations, do not have lenses and most use the halogen lamp. They are used in many situations requiring a wide beam coverage and generally soften light quality. Portable units are also available which can be held in the hand and which operate from exchangeable batteries. These are widely used in newsreel and documentary filming when speed and mobility are essential in "getting the shot".

Photofloods:

Photofloods are very much like household incandescent lamps. They are available in various power ratings from 100 to 1.000 watts in colour temperatures from about 2,900°K to 3,400°K. Photofloods have a life of 4 to 6 hours, but they tend to change colour temperature when they become older (the glass envelope will blacken), and they will decrease in intensity with age. They also change colour temperature with changes in line voltage. The greater the voltage the colder (bluer) the light, the less the voltage, the warmer (redder) the light. Photofloods may be rated to run at from 115 to 120 volts.

Many photofloods can be screwed into ordinary sockets, and there are a great variety of shapes and sizes of reflectors for use with these lamps. Some photofloods have built-in reflectors. When mounted in reflectors, photofloods may be used for either direct or bounce light.

Halogen Lamps:

Like photofloods these are incandescent lamps, but instead of a glass envelope surrounding the filament, the filament is encased in quartz or a similar material in an atmosphere of vaporized halogen gas, such as iodine or chlorine. Halogen lamps are also known by the names quartz lamps, quartz-iodine lamps and tungsten halogen lamps. They are compact, bright, long-lived, and maintain the same colour temperature throughout their entire life.

They are available at different brightness levels and colour temperatures from about 2,900°K to 3,400°K. The most common colour temperature is 3,200°K which matches most motion picture filmstocks.

Because halogen lamps are so bright, the use of a dichroic filter can provide bright light of daylight colour temperature. A dichroic filter mounts in front of the lamp and suppresses the passage of the red end of the lights output. Some halogen lamps come with a built-in dichroic filter.

USE OF LIGHTS FOR INDOOR AND STUDIO WORK

For the majority of all indoor and studio work artificial lighting is used. It has the great advantage of allowing a much higher degree of control over the appearance of the photographic image than available light. It allows the cameraman to choose whatever kind of filmstock he wishes: if he requires very fine grain and maximum sharpness he can choose a very slow filmstock and use plenty of lighting, if he needs a noticeable grain and high contrast, he may select a high speed filmstock and reduce the level of illumination or stop the lens down.

Artificial lighting also provides pictures of good contrast which is often lacking in general interior camerawork with the available natural light.

There are two main categories of lights: floodlights and spotlights. Floods provide a wide angle of over-all illumination for raising the general level of lighting, while spotlights provide small areas of concentrated light for more intense illumination of restricted areas. Many lighting set-ups comprise both lights. Floodlighting especially for background and soft overall lighting is often achieved by the use of a bank or through consisting of several smaller reflectors grouped together to form a unit. Such compound units often have a diffuser fitted over them, to ensure that the light is soft and even. For spotlights a range of accessories is used to control the area on which the light is directed. Barndoors are adjustable flaps attached to the lamphead, which enable the operator to cut off the light beam at the bottom, top or either side of its area to determine accurately the bounds of the illumination. A snoot is a conical attachment which fits over the lens of the light, directing it into a small circular area. The position in which the lights are placed, and the lighting function they carry out can be loosely described by the terms 'key light', 'fill light', 'back light', 'background light', 'spot highlight' and 'bounce lighting'. Although these terms have general significance, it is misleading to think of them as precisely describing the functions of the lights, as in many cases the effects overlap, and in most cases therefore only some of the lights will be used.

The key light or the modeling light provides the main illumination for the subject in the scene. It is often used as the reference point for the calculation of the exposure: the light reading is taken from areas illuminated by the key light, and the level of the other lighting in the scene is brought up to this level.

The fill light is used to fill in the shadows created by the key light, and should not create additional shadows. The fill light is normally placed near the camera-subject axis, and is of a slightly lesser intensity than the key light. When moving light away from the subject, one has to bear in mind, that the intensity of the illumination provided falls off in an inverse square ratio to the lamp to subject distance: i.e. at twice a given lamp-to-subject distance the intensity of illumination provided will be one-quarter, not one-half, of its original level.

The rim light or back light is placed facing towards the camera from a position behind the subject. It can be used to provide highlights on a limited area of the subject (for example the hair), it can also create a silhouette effect and it can be used to accentuate the outline of a subject against its background. This last function is mainly important in b/w film, where often no marked colour difference between subject and background exists.

Background light is often provided by wide floods or banks of lights so placed as to bring the lighting in the overall composition to the level required to maintain a desirable brightness ratio.

Spot highlights may be used as necessary to accentuate details. This is particularly important in b/w films, where a brightly lit area of the screen is a powerful means of attracting the eyes of the audience onto this part of the scene.

Bounce lighting is indirect lighting, where the lighting source is aimed at a wall or at the ceiling to provide overall illumination. There are special umbrellas, silver surfaced, with provision for mounting the lighting source, which provide greater illumination on the walls of the ceiling and therefore a greater intensity of the reflected light. If the reflecting areas are not white or neutral gray, the reflected light will pick up the colour and will colour the subject. While this makes no difference when working with b/w film, it causes colour shifts visible in colour film. It is also necessary to preserve a good balance between the bounce light and other sources of illumination otherwise the scene can look very flat.

If filmstock and lenses are fast enough a mixture of bounce lighting and high wattage tungsten or photoflood lamps which substitute ordinary electric lamps can give very good results. This style is especially suitable for shooting indoor locations because it preserves a great deal of the character of the original illumination.

Lighting styles fall broadly into two categories, determined according to the brightness ratio of the photographed image: the high-key and the low-key set-ups. In *high-key lighting* the illumination is almost uniformly bright, and it has a very low brightness ratio of 2:1 or 3:1. High-key lighting, which has nothing to do with overexposure, is frequently used to enhance moods of cheerfulness, fantasy, gaiety and purity. *Low-key lighting* shows a large brightness ratio, for example, when one figure or a face is lit in an otherwise black screen. This wide difference between brightest and darkest areas is often used to underline tension, drama or mystery. Most lighting set-ups fall somewhere in between the two extremes and the definition of lighting set-ups by their key is a relative and fairly general classification.

While working on a lighting set-up for a film scene one very important thing has to be kept in mind: in film-making, *movement* is lit and, as the subject or the camera move, light relationships and intensities may vary. A figure walking about in a room will need to be lit throughout its movements. Moreover, the lighting must be arranged so that light levels do not fluctuate in a manner inconsistent with the apparent lighting suggested by the screen image.All shots containing movement must therefore be thoroughly rehearsed before the take. The same applies to movements of the camera. When the camera is moved during a shot, care must be taken that the whole area appearing in the shot is lit in the appropriate manner. Furthermore, camera movements can prevent certain placing of lights. A light used for a set-up might appear in shot, say, at the end of a pan. Cables too, can easily be overlooked and appear in the shot. A further danger from moving the camera is 'flare' - hexagonal patches of light appearing on the film. They are a result of stray light entering the lens directly from a light source, especially from back lights.

Shadows are also easily overlooked, not only the multiple shadows cast by the subject (one for every light source used to lit it) but also extraneous shadows of camera, crew and equipment.

Continuity is as important in lighting as in other areas of film-making. Lighting set-ups must be checked from shot to shot when they are to be cut together, and lighting log-sheets are very useful in keeping detailed records of the set-ups used during the shooting of a scene, especially when there are breaks in the shooting. Rendering of colours evidently the same also must be kept consirtent from shot to shot. Other details to bear in mind include the treatment of on-screen light sources. Alterations of these, for example the switching off of a light in a scene have to be balanced by a comparable reduction in photographic lighting.

Mixed lighting for colour filmstock

Shooting in colour in conditions that necessitate a mixing of natural light and artificial light, for example shooting indoors during the day, will normally create a discrepancy between the colour temperature of the two light sources. This problem is two-fold. First, there is for example, a room, lit by 3,200°K lamps and a view out of a window is included in the shot. The second problem is the light which falls through the window into the room and mixes there with the artificial lighting. If no filters are uses while filming with filmstock balanced at 3,200°K the light passing through the window, or seen through the window will be recorded on the film as bluish in colour, since its colour temperature is about 5,500°K. This mixture can be very pleasing. If it is preferable to balance one or the other of the light sources, filters have to be used.

One could use filmstock balanced for either 3,200°K or 5,500°K and filter it perhaps for some intermediate value.

If the light coming through the window is much brighter than the interior illumination, it would probably be best to use daylight balanced filmstock, and for the interior illumination lamps are filtered for daylight. The other way would be to filter the light coming through the window. Large sheets of acetate and plexiglass material are available which work very much like a 85 filter. They are tacked or taped onto the window and will convert outdoor light to 3,200°K. Then a filmstock balanced for artificial light has to be used.

Since the light which comes in through a window is often brighter than the artificial lighting, these filters would also serve to reduce the illumination level coming from that source and so prevent overexposure of those parts of the scene which are mainly lit by this light source. If necessary the filter rolls or sheets can also be used in conjunction with neutral density sheets to hold back more of the light passing through the window. Natural density sheets can also be useful when filming in b/w stock, in order to bring the outdoor exposure to a level with the indoor exposure.

Outdoor Lighting

In the majority of situations the light from the sun, the sky and the light reflected from the surroundings, has a high enough brightness level to allow good exposure. Even in Jamaica the weather as such does not play such a crucial role in outdoor shooting as it does for example in Europe, it is useful to keep in mind, that clear sky and strong sunlight will provide a strong illumination and high colour temperature, but will cause a high brightness ratio and give strong contrast. A cloudy day may provide equally strong illumination, and possibly equally high colour temperature, but will give an evenly distributed, softer light, because the thin layer of clouds will act like a diffusing screen. These conditions may produce better pictures, especially on colour filmstock, for the brightness ratio of subjects will be considerably reduced, and a better rendering of colour will result. Cloudy, dull or rainy days, however may provide a light giving too little contrast and produce flat pictures.

Strong sunlight, which is in general the most common condition in outdoor shooting in Jamaica, demands particular care. It provides a strong directional light, comparable with the effect of a key-light in controlled artificial lighting set-ups. With strong sunlight as the only source of illumination, the pattern of shadows will be very evident on the screen. Their effect on, for example, the modelling of a face, or other essential contours of a subject must be controlled. Especially faces with darker skin may look very flat. The simplest solution to the problem is to use a reflector as a supplementary fill light. A reflector can be made with aluminium foil, a white card, a white cloth, even in cases of emergency, a newspaper. A white wall can also be used as a reflecting light source. There are also commercially produced reflectors available. A reflector has several advantages over the use of additional artificial lighting. The reflector will not change the colour temperature of the available light. It will rarely overexpose or wash out what should be filled in. There is little danger of casting an additional shadow. An alternative to the reflector is the use of some form of artificial light, such as used indoors, if an outlet is available, or a battery operated portable lighting unit. But then care must be taken to match the colour temperature of the artificial fill light to the colour temperature of the outdoor light. Most lighting sources can come equipped with a special filter to transform their normally 3,200°K illumination to match outdoor 5,500°K to 6,000°K.

Another problem which can arise when filming in strong sunlight can be the difference in brightness ratio of sunny and shadowy areas, especially when a subject moves from one to the other or the movement of the camera comprises both areas in one shot. The low brightness range of most colour films will not allow a successful exposure in both sunlight and shadow, and some management of either the exposure or the light will be necessary. The exposure could be calculated as a mean between the two extremes, to give reasonable exposure in both areas, if the ratio is not too great. Otherwise the stop has to be changed during the take. If this is not possible the shadowy areas have to be lighted either by artificial lighting or by reflectors.

The angle of incidence of the light, particularly strong sunlight, is another critical factor in outdoor filming. The angles between the light source and the subject, and the subject and the camera offer a wide range of lighting effects. Possibilities of flat lighting, with the sun directly behind the camera, of side lighting, back lighting or rim lighting present themselves. Also effects like contre-jour filming i.e. directly against the light, and the deliberate use of flare can be tried.

Continuity for natural light presents an extra problem, since the sun shifts continuously and the angle of strong direct light also changes. If an extended period is necessary to shoot a scene of apperently short screen time, it may have to be shot on a series of one or two hour sessions on different days, rather than throughout one day.

Night-for-Night

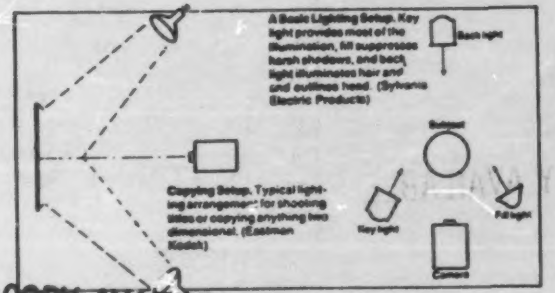
If using colour filmstock when shooting at night outdoors, it is best to use a filmstock balanced for either 3,200°K, or 3,400°K. Most lighting units will provide light with this colour temperature. If an event is filmed which takes place at night-time like in newsreel or documentary films, the light or lights, often have to be placed from the direction of the camera. Such direct front lighting is often unpleasant and produces pictures of people which are in most cases unflattering. If possible it is better in most cases to have an assistant holding the light at an angle to the subject. Shooting at night for a night-time effect is usually more difficult than straight newsreel type lighting, since this type of lighting is not the natural or realistic one. Usually it is best to light the scene if it is supposed to be taking place in total darkness for the highlights that might be produced by moonlight or street lamps.

Day-for-Night

This technique simulates a night-time effect, but the shot is filmed at daytime. The impression that the scene takes place at night is mainly achieved through underexposure and an overall bluish cast.

Here several points have to be taken into account: the 85 filter normally used to convert 3,200°K film to daylight is removed. This produces the bluish effect. If the sky appears in the picture and the scene has to be shot with the sky, it is possible to reduce the brightness of the sky by using a polarizing filter. The sky will be rendered dark enough only when the camera is at right angles to the position of the sun.

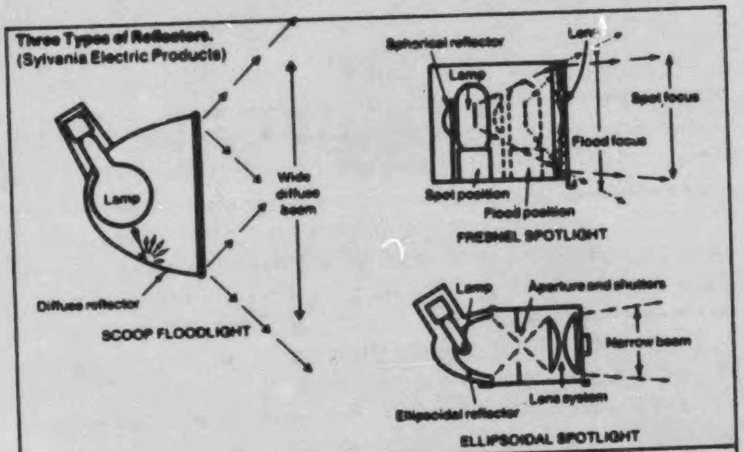
Exposure is calculated as if no filter is used. So the necessary underexposure of usually two stops is achieved. Panning movements of the camera should be avoided, but track shots in the optical axis or vertical towards it are possible. Neutral density filters cut to mask only the sky area may be used to further darken the sky. Care must be taken so that the cut out N.D. filter covers only the area to be darkened. Since colour vision is restricted in darkness, no lively colours should appear in the scene, neither as clothing nor as make-up. Moonlight normally has a bluish tinge, but it is often better to add the bluish cast later in the lab, than to use an additional blue filter, or remove the 85 filter. If day-for-night shots have to be done in twilight because of the use of on-screen light sources, it is usually better to use filmstock balanced for daylight, since filmstock balanced for artificial light in this case would produce a very marked bluish cast. The light sources which appear on screen normally would show a noticeable reddish tinge, therefore windows of houses for example should be corrected with a light blue filter. If the twilight illumination is bright enough that shadows appear, it is necessary to light the shadows with artificial lighting balanced for daylight. In general day-for-night shooting is rarely convincing and a better approach may be to shoot at night.



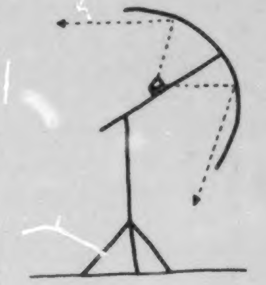
A Basic Lighting Setup. Key light provides most of the illumination, fill suppresses harsh shadows, and back light illuminates hair and and outlines head. (Sylvania Electric Products)

Copying Setup. Typical lighting arrangement for shooting titles or copying anything two dimensional. (Eastman Kodak)

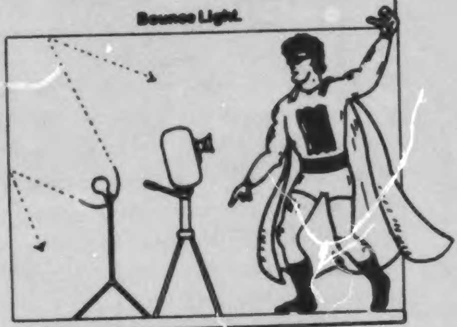
Three Types of Reflectors. (Sylvania Electric Products)


Lamp
Wide diffuse beam
Diffuse reflector
SCOOP FLOODLIGHT
Spherical reflector
Lens
Lamp
Spot focus
Flood focus
Spot position
Flood position
FRESNEL SPOTLIGHT
Lamp
Aperture and shutters
Narrow beam
Ellipsoidal reflector
Lens system
ELLIPSOIDAL SPOTLIGHT

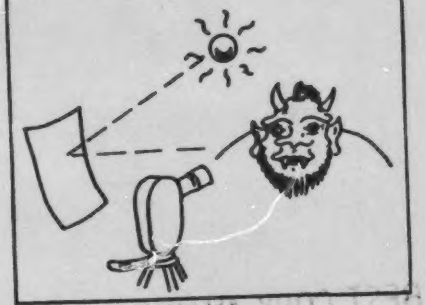
Umbrella Light.



Bounce Light.



Use of a Reflector. To make your subject even more handsome, use a reflector to *fill-in* dark shadows.



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THE EXPOSUREMETER

Exposure depends on several factors: the lighting conditions, the speed of the film, the influence of filters, if any are used, the opening of the shutter and the aperture of the lens (f. stops).

Accuracy of exposure is very important in film-making. If negative filmstock was used for shooting, poor exposure can be compensated for in the lab only to a limited extent. If reversal filmstock was used nearly nothing can be done in the lab. With colour film accurate exposure is even more important because inaccurate exposure not only gives a too dark or too light image, but also affects the colour rendering.

The most important tool of the film-maker to calculate exposure is the exposure meter.

Exposure meters vary considerably in design but all perform basically the same function: they translate the intensity of the light falling on their sensitive cell into figures. From these figures the cameraman can calculate, usually by scales on the meter itself, the amount of exposure necessary to produce a good result at the emulsion speed to which the meter is set. Some cameras contain built-in exposure meters, which work with varying degrees of automaticity.

The light sensitive cell of exposure meters is either a selenium cell or a cadmium-sulfide cell. Selenium cells transform the light which falls on them directly into electric current. Generally the voltage they can produce is not more than 0.5 volts, their power in the best cases only 20 microwatts, but this is enough to produce a deflection of the exposure meter needle.

Cadmium-sulphide cells do not produce current themselves, but change under the influence of light, the electric conductivity of a circuit. Therefore a cadmium-sulphide cell needs electrical energy from a battery and acts only as a rheostat. The more light falls on the cadmium-sulphide cell, the more current will flow, the less the light it catches, the less will be the current. The power output of the cadmium-sulphide cells is depending on the cell type, up to 50 milliwatts, bigger than that of the selenium cells. Because of their higher output CdS cells are used in built-in exposure meters with automatic exposure control.

The main advantage of CdS cells as compared with selenium cells is that they are able to measure very dim light. Selenium cells do not react to less light as given by a standard lamp in a room, whereas CdS cells are able to measure moonlight or candlelight. One peculiarity of exposure meters which work with a CdS cell is that since they work as a rheostat, the deflection of the exposure meter needle sometimes is slow. This lag is more marked in a transition from brightness to darkness than vice versa. Therefore the exposure meter should always be kept in its case and should be taken out only to make the measurements.

Besides the ability of CdS cells to measure even very dim light, exposure meters which work with selenium cells and those working with cadmium-sulphide cells are comparable, also as far as the measured results are concerned.

There are two techniques, and two kinds of exposure meters. One type measures the light reflected by the subject and is called reflected light meter. These are available as separate device and as built-into the camera meters. The other type measures the light falling on the subject and is called incident light meter. The last one is only available as unattached or in-the-hand meter.

Reflected Light Meter

Since the reflected light meter measures the light reflected by the subject, it is held at some reasonable distance from the subject, between the subject and the camera.

For landscapes, it would be pointed at the landscape, in the case of a persons face it would be brought to within a foot or inches of the face. Care has to be taken when measuring a landscape or any big subject outdoors, to exclude registering the sky's illumination. Including the bright sky would make the meter see the overall scene as brighter than it is. This could result in underexposure of the important parts of the scene. Therefore the exposure meter should be pointed at a forty-five degree angle to the ground.

When measuring a person's face, or any other small object and the reading is taken close to the subject, care has to be taken not to cast a shadow on the subject which would make the meter read less than the full amount of light striking the object. For general use in film-making, for long shots, evenly illuminated scenes and most exteriors, a reflected light reading will give a fairly accurate reading of the light available. If portions of the scene, other than the important one which is normally measured, are much darker or lighter, they may not be properly exposed. In these cases it is usually better to take several readings to adjust the exposure.

Spot Meters

Spot meters are a very special kind of reflected light meter. They take a reading from a small field of view, appr. a few degrees, whereas normal reflected light meters cover a broad field of view, generally around fifty or sixty degrees. With spot meters the subject is sighted through a finder.

The spot meter can function as a highly accurate general purpose meter. By aiming the meter at various parts of the scene and noting the various readings, a composite for a good reading may be obtained. If, for example, in a scene a man is standing with his back to the sun which is already low with appr. forty-five degrees above the horizon, but the day is still bright, we would get the following readings: For the man's face f/8,for the green grass in the field f/16; for a clump of rocks f/11,for the man's clothes f/5.6,for his yellow hat f/22 and for the sky f/32. A close up of the man's face would call for an exposure of f/8. If more should be included, say in a head and shoulder shot, f/8 would be still alright, or, if more saturation of the background colour is what the scene would call for, we should stop down to f/9 or f/10. For a shot of the full figure of the man and the field, f/11 might be a reasonable compromise, and if the silhouette of the man against the sky and the field is what is needed, at least f/22 would be called for.

This example not only shows out of how many different readings the cameraman has to find a compromise, especially when shooting outdoors, but it also shows, that there is no right or wrong exposure, but that exposure has to be related to the purpose of the shot or the scene.

Because spot meters take in such a narrow field of view, they are also useful for measuring a small subject area from a relatively great distance, for example an event taking place on stage illuminated with a spotlight. In these cases it is often not possible to bring an ordinary reflected light or an incident light meter within the necessary reach of the subject.

Incident Meter

The incident light reading responds to the light falling on the subject. Therefore the meter is brought near the subject to be filmed and its light sensitive cell is pointed towards the camera. The light sensitive cell of incident meters is covered with a hemisphere of some translucent material which acts as a diffusion screen to avoid distortion of the reading by bright highlights.

An incident light reading is often useful for close-up filming, for animation and rostrum work and for scenes of high brightness ratio. Generally speaking in close-ups, the incident meter will give accurate readings for most situations. However in shooting subjects with light or dark backgrounds,modification of the reading should be made. One half stop increase for dark backgrounds and one half stop for light backgrounds. These are approximate.

For measuring the brightness ratio the incident light meter is well-suited. The key light on a set is the main light used to model the subject, the fill lights are those used to fill in the shadow. The contrast ratio is the ratio of the brightness of the combined key and fill lights to the fill light alone. It is a measure of the ratio of the brightness area of light falling on the subject to the area of fill light. The lighting ratio may be determined with the incident meter by replacing the hemispherical shell (diffusion screen) with a flat white translucent disk. With the disk facing towards the lights we can measure the key plus fill and then the fill light alone. Incident meters can give readings either in f-stops or in foot-candles. If the meter shows that the light falling on the brightest portion of the subjects face is 250 foot-candles (or f/8) and the fill light is 125 foot-candles (or f/5.6) the lighting ratio is 2:1. Since colour filmstock have less latitude than b/w filmstock they can cope with a high brightness ratio and some lighting technicians would even say that more than 3:1 will not give satisfactory pictures, although a higher ratio may be used for special effect. It is useful while filming with colour stock to determine the brightness ratio of the lighting used. It is often necessary to measure the brightness ratio if there is any likelihood that parts of a scene have to be reshot later.

GREY CARD

Sometimes the need may arise to take an incident light reading but either the exposure meter at disposal is not suitable for that purpose or the subject itself makes it physically impossible. A method of adapting a reflected light reading for judging the average light reflectance of the subject with a large brightness ratio is the grey card method. The grey card like that manufactured by Kodak is a piece of carton with a white side which reflects approximately 90 % of the light falling on it and a side of neutral grey with a reflectance of approximately 18 %. The grey card is placed near the subject and a reflected light reading is taken. If the meter does not cast a shadow on the card and if the lights behind the card, if there are any, are switched off, an exposure calculated from this reading will indicate a good exposure for the average of the scene. A high brightness ratio may also be dealt with by averaging out the reading from the brightest area with that from the darkest by measuring with a grey card.

Whatever system is used, the meter can at best only tell what light is there and recommend an all-purpose exposure. For instance in the case of extreme contrast, it may be desirable to keep the brighter part well exposed and let the darker area remain unexposed, or conversely, if the important action takes place in a shadow area, it may be necessary to accept overexposure in a highlight in order to see what is going on where it really matters. Since the exposure meter can not see the nature of the subject, in these and in many other cases, the cameraman must use his judgement and experience in suiting his exposure to the particular circumstances.

CAMERA WORK

CAMERA ANGLES

Moving about in our daily life perception is not only formed by our visual sense but conditioned by experience. We know that rooms have depth, that people walk erect, that the proportions to the space they occupy vary only so much. Normally, no matter which part we see of a person, we tend to think of him as a whole.

In film it is the camera which creates this aspect for the audience. The camera angle determines the audiences viewpoint and the area covered in the picture. So each time the camera is set up, two questions arise: How much area should be included in this shot? Which is the best position to film this portion of the event?

AREA

The area covered in the shot determines what and how much the audience should see. It fixes the size of the subject(s) shown in the picture, their relative distance to the viewer, their relation to the overall picture frame and through all this helps to establish and qualify the space itself. For example, distance of the subject(s) generalizes, proximity of nearness particularizes, distance removes, proximity reveals, distance relaxes, proximity intensifies.

The size of the subject in relation to the whole picture area is determined by

1) the distance of the camera from the subject,
2) the focal length of the lens used to make the shot.

The closer the camera, the larger the image. The longer the lens, the larger the image. The converse is also true: the further away the camera, the shorter the lens, the smaller the image.

The subject size may vary in different shots by altering the position of either the camera or players or by employing different lenses. The area filmed may vary during a shot either by moving the camera or the players or by using a zoom lens and vary its focal length as the scene progresses.

Thus a long shot may graduate into a close-up, a close-up become a long shot, in one single shot.

The type of the shot filmed is defined with regard to the subject matter and it's image size in relation to the overall picture area. This is the only practical definition, since not only the actual distance between camera and object and the length of the focal length, but also the size of the subject filmed, determines the content of the picture. The camera distance to the subject would vary greatly in filming a close-up of a human baby or of a baby elephant! A head close-up, therefore depicts full screen a head regardless of the distance of the camera and the lens employed.

Still, there is some flexibility in the terms used, since, as one author puts it, a long shot of the Sahara may be a close-up of the earth. But the following terms are more or less employed to describe requirements in general terms.

Extreme Long Shot

An extreme long shot depicts a vast area from a great distance. For example a large ranch, a city skyline or a football stadium. In this type of shot details become relatively obscure. It establishes the geography of a local and provides the audience with an overall view. To give the right perspective, it is often filmed from a high point like a camera platform, the top of a hill or building, or a plane or helicopter.

Long or Distance Shot

A long shot embraces a large area, but the important elements are visible in a little more detail. A long shot may include a street, a house or a room, or any location where an event takes place. The long shot should be employed to acquaint the audience with the entire area of action and with all the elements within the scene. So viewers will know who is involved and where the players are located, and how they are related to each other in space.

For this same reason, a long shot is often used after a series of closer shots in which players have moved considerably.

Full Shot

Full shots are shots which cover the subject, but do not depict the overall setting in its entirety. In the case of human beings it shows the full figure, in the case of objects the complete object.

Medium Shot

A medium shot depicts the players from above the knees or from just below the waist to the head. While several players may be grouped together in a medium shot, the camera will be close enough to record with clarity their gestures, facial expressions and movements. Medium shots are good for dialogue scenes and television filming. Generally medium shots have many narrative uses, as one or more of the players can be followed by the camera, and also enough of the location is shown, so that the viewer knows what is happening and where it is happening.

Two Shots

A very widely used type of medium shot is the two shot, where two players confront each other and exchange dialogue. There are numerous variations of the two shot. The most widely used is that in which both players face each other. Traditionally dominance of one player over the other is achieved through dialogue, action lighting which favours one player or through the camera angle on the players. The nearest player is then slightly turned away from the camera and the farther one filmed in a three quarter angle. Or, one player may appear in profile and the other facing the camera at a three-quarter angle. On the wide screen, where the players do not fill the screen, dominance of one player and the relation of the players towards each other can be achieved through the composition of the environment, the side and the space between them. (See composition for the whole question.)

Close-up

A close-up of a person is generally designated in the script according to the image size.

Medium Close-up

is a shot which films a figure from approximately midway between waist and shoulders to above head.

Close-up

is a shot which includes only one object: head, a foot, a basketball etc.

Choker Close-up

is a shot which shows only the facial area of a player just from below the lips to just above the eyes.

Extreme Close-up

is a shot which depicts only a small portion of a larger object, an eye, a machine part or a raindrop for example.

Since the close-up is a device unique to motion pictures a little bit more should be said about it.

The close-up presents a detailed part of the person or object on a large scale. It involves the viewer "closer" into the scene.

Two types of close-ups can be distinguished; the cut-in close-up and the cut-away close-up.

The cut-in close-up is always part of the main action. It isolates a significant subject matter and eliminates all non-essential material from the view. A close-up is very intimate, it is difficult for the viewer to distance himself from what is shown. Therefore close-ups are used to highlight narration and to reveal important aspects of the subject. It is also used to provide a time lapse. A lengthy or repetitious action need not be shown in its entirety. If the audience sees a person beginning to write a letter, then a close-up of the player and/or a close-up of his fingers striking the typewriter keys, and finally pulling out the finished letter, it will accept and imagine that they have seen the entire event and will not miss the missing sections.

A close-up can also substitute a hidden action, which can not be shown out of technical or other reasons. Close-ups of the machine operator handelling the switches and/or the control pannel, can bridge a shot of filling in raw material and a shot of the emerging finished parts. A close-up can also be inserted between a long shot and a medium shot which may not match together because of differences in players' positions, looks and movements.

Cut-in close-ups may be filmed from four camera angles: objectively, subjectively, point-of-view and over the shoulder. In the last case the camera films the close-up over the shoulder of the opposing player. These shots are generally filmed in matched pairs, when two players confront each other and exchange dialogue. It is therefore important that the view over A's shoulder to B, gives the same impression as the view over B's shoulder to A. This does not mean that the camera distance, camera angle and image size need be exactly the same in linear measurement. An exact match is sometimes difficult to achieve, because of the players' differences in height, body contour and head size. The important point here is that the audience gets the impression that it looks over both shoulders in the same way.

The over the shoulder close-up also provides an effective transition from objectively filmed shots to point-of-view shots. The camera is thus moved around from an objective angle to an intermediate angle which introduces the point-of-view close-up that follows.

A cut-away close-up is related to, but not a part of the previous scene. It depicts secondary action happening simultaneously elsewhere.

Cut-away close-ups may be used to present reaction of off-screen players to the events, or to comment the principal event by showing corresponding action. It is also often used to cue the audience on how they should react. It can replace scenes which are too gruesome or too expensive to shoot. So the horrified face of a bystander accompanied by a crashing sound makes quite clear to the audience what has happened after it has seen several shots of two cars approaching each other. A close-up of a checked flag starting a car race is an example of how a cut-away close-up can motivate a scene.

Cut-away close-ups can also be used to distract the audience. So for example the face of an Indian looking off-screen does not only heighten the expectations of the viewers but can also cover directional change in the screen travel of a cavalry. Close-ups portray details on a large scale. Greatly magnified movements - such as throwing a switch or swinging a tool in position - appear highly accelerated on the screen. In theatrical films it is normally no problem to match the timing of the players movement in a close-up to that in bracketing scenes. To match the tempo in nontheatrical films, where industrial training or scientific personnel operate machinery, the person performing a small action in a large close-up should therefore move with deliberate slowness, so that hands, fingers or tools do not appear to flash in and out of the picture.

Differently timed movements in wider shots and close-ups prevent cutting on action and force the editor to resort to statically positioned close-ups, after movement into the frame is completed.

Inserts:

Full screen close-ups of letters, photographs, newspapers, signs or any written or printed material, are called inserts. Generally inserts are filmed so that they overlap the frame slightly, thus eliminating background. If they do not fill the horizontal frame, so that portions of the background is visible, it is best to film them during regular production, and not, as is usually done out of economic reasons, after the principal shooting is completed. If parts of hands or fingers which hold the material are seen in the shot, they should match the positions in the bracketing shots.

Further Descriptive Terms:

Professional production personnel employ many additional descriptive terms which identify further the type and/or content of the shot. Cut-in and cut-away close-ups are examples already mentioned, as is the two-shot. The descriptive terms derive either from the angle in which the camera is positioned towards the filmed subject, from the type of lens which is used to film this particular shot or from the way in which the camera in this shot moves.

Since definitions and usage of these terms vary widely during the industry the most important thing is that their meaning is the same within the group producing a film.

FOCUS

The objects to be filmed are situated in depth, therefore their distance to the camera lens differs. The film-maker has two alternatives: he can either choose to film in deep focus in which foreground, middle ground and background are all relatively sharp in focus or he can emphasize one ground over the others by using shallow focus where only one plane of the whole image is clear. Since the human eye will always seek out the sharpest object in a picture, shallow focus is one method to attract the viewers attention towards one point of the entire picture.

Furthermore there is the continuum between sharp and soft focus. Sharp focus in general is more associated with realistic style, whereas soft focus is more connected with so called romantic moods. But since soft focus smoothens details, it also distances an image. Focus changes within a shot are of two basic sorts. Follow focus is used to keep a moving object whose distance to the camera changes clear and sharp. With rack focus the point of sharp focus changes from one plane of the image to another to direct attention from one object towards another one in another ground of the image. Focus pulling can be done by two operators, if all focussing distance can be worked out before the shot and the lens has an accurate focussing scale. With a small reflex camera it is easier done by the cameraman himself, especially when a small handle is clamped on the focussing ring to keep stray fingers away from the lens.

VIEWPOINT

The other variable which defines the image is the viewpoint. The viewpoint is the cameramen's answer to the question "How to shoot something". It sets the aspect, the way in which the audience sees the object depicted. First of all the viewpoint is determined by the camera angle, i.e. the positioning of the camera towards the object. Since the relation between the camera and the filmed object exists in space, the camera can be positioned in three distinct ways, hence there are three different angles.

1. The Angle of Approach or Subject Angle

This angle is either square or oblique. The camera films an object either square-on or more or less from the side.

If the camera looks at a subject square-on, it normally records only one of its surfaces, the picture appears flat. If the camera is angled sideways in relation to the subject, more than one surface is shown, the result is a depth effect. The Hollywood code in general stressed the subject angle and preferred a forty-five degree or so called three quarter angle and avoided shooting square-on.

Since all subject matter is solid and has three dimensions, it is generally better to angle the camera to produce the illusion of scenic depth. But out of narrative reasons or to create a certain impression of the subject filmed a flat treatment may be preferred.

2. Camera Height

This is the angle created through the height of the camera in relation to the subject. The camera can look at an object either from the same height, from above or from below it. Level angle, overhead and high angle, and low angle are the basic terms used here.

Since there are cameramen who simply adjust the camera's height so, that it is convenient for them to look through the finder, it is necessary to stress, that camera height always means its elevation in relation to the subject matter, regardless of the length of the cameraman.

Level Angle

Level angle basically means that the camera is positioned at the same height as the object filmed. This seems easy but it is often difficult to define. On the one hand, level angle shots are those which give a normal, undisturbed view of a subject. On the other hand, they are defined by the height of the depicted object itself.

General scenes which present a view as seen by an outside observer are as level angle shots filmed from the eye-level of an average standing person, i.e. the camera is about five and one half feet above the ground. In a close-up of a person a level angle shot is filmed from the subject's eyelevel, whether this person is sitting or standing. Therefore for instance it is necessary when moving in from a long shot to a close-up, to adjust the camera height to the particular subject being filmed. If this is not done and for example the filmed person is sitting, a high angle shot will result. A subject's eyes, plus the intimate relationship between viewer and player desired in a level angle close-up are completely lost if the subject is recorded in a high downward angle which shows top of the head, half closed eyelids and a distorted view of the player.

The same holds for a close-up where the player addresses the audience and if not filmed from his eye-level has to look up or down in order to look into the lens.

Because level angle shots provide frames of reference and present an easily identifiable viewpoint, they are best for normal close-ups of people and for shooting general scenes. Since a level angle camera views a setting or an object so, that vertical lines do not converge, walls and sides of buildings will remain true. Therefore for technical and scientific films level angle shots are preferred to present an undisturbed view on tools, machinery and instrument panels.

High Angle

A high angle shot is any shot in which the camera is tilted downwards to view the subject.

All angles are relative and again it is the height of the camera in relation to the filmed subject which counts. High angle therefore does not necessarily mean that the camera is positioned at great height. To look down on a small object, the camera may be even placed below the cameraman's eyelevel.

High angle shots may be chosen for psychological, aesthetical, narrative or technical reasons.

Looking down does not only reduce the height of the filmed object, but also diminishes its importance, so that the audience may feel superior over both, the player and the situation.

High angle shots also acquaint the audience with the geography of a setting, important when filming an industrial complex or a construction site. They also show better a subject matter laid out in a pattern upon the ground like a football game, a garden, a production line or an animal migration. The camera may also look down on a subject when it films the view of one player on another and a difference in height exists. For instance the view of an adult on a child or a standing person on one who is seated.

Technically high angle shots make it easier to keep action occurring in depth in sharp focus, since a high angle shot covers the same front-to-back area with less difference between near and far focus than a level angle shot.

A high downward angle or an overhead shot should be used with discretion on fast moving action, because movement seen from this angle appears slower than it really is. The slow effect is greatest with movements on the vertical of the picture frame, i.e. toward or away from the camera and less apparent crosscreen. Furthermore the speed of movements in such scenes may not match the tempo of similar shots filmed at level angle unless undercranked.

Low Angle

A low angle shot is any shot in which the camera is tilted upward to view the subject. Again it is the relation of the camera height towards the subject which matters. First of all low angle means that the audience looks up to the subject filmed, that its height is increased and so its power is emphasized.

Therefore it may be useful in filming important characters or to give one player dominance over the others. This effect can be further increased in these shots, if the important player steps forward as the action is at a significant point.

Low angle shots are also employed when one player looks up to another one who is situated higher or actually taller. Low angle shots separate players or objects and can be used to eliminate unwanted foreground.

Since they also drop the horizon and remove all background identity, low angle close-ups can be filmed almost anywhere. Therefore editing problems discovered when the film is assembled can be solved by inserting such a low angle reaction close-up which can be filmed even after shooting is finished. In theatrical pictures low angle interiors are rarely filmed, because normally they would also depict the overhead lighting. In actual buildings inclusion of the ceiling, particularly an expressive one through a low angle shot, may intensify the image and identify the player more with the setting. Low angles cause people, objects and structures to loom up in an image, because they are recorded with a broad base and a diminishing perspective. In filming natural or man made structures the inherent distortions normally are acceptable because viewers have been conditioned to these perspectives and know that the converging lines are parallel. When filming players however, especially with a wide angle lens, which emphasizes the optical effect, care must be taken or a caricature may result.

3. Dutch Angle

In both sets of camera angles described above, the horizontal and the vertical axis of the subject matter are parallel to the vertical and the horizontal of the image frame.

In the Dutch angle the camera is bend sideways, so that the vertical axis of the camera is at an angle to the vertical axis of the subject depicted. The result is a picture which slopes diagonally off balance. Since the vertical of the subject is depicted as a diagonal in the picture frame, the stability of the image seems destroyed. Therefore the Dutch angle must be used with discretion and should be reserved for sequences where weird, unstable, violent, out of the world effects are required. A Dutch angle may be used for example to mimic the movements of the horizon as seen from a boat in heavy seas, or for instance show a player who has lost his equilibrium, is drunk, delirious or in a highly emotional state.

Dutch angles may also be employed in montage sequences, for creating an overall impression of passage of time or space. In a similar way it can be used in research, industrial or documentary films that require dynamic depiction of a great deal of action in small snatches which show mere glimpses of the events.

The tilt of the Dutch angle should always be deliberate, never just a little off level, so that only the slight slant of the image seems accidental.

The angle of the tilt is also important. The vertical and the horizontal of the subject matter are converted into diagonals in the image. As has already been mentioned, a picture composed mainly in diagonals conveys a certain impression. A diagonal running from lower left to upper right suggests ascent, while one that slants from upper left to lower right suggests descent. Therefore a subject that bends to the right tends to convey the impression of forcefulness and action, whereas one tilted to the left appears to be weak and static.

TYPES OF CAMERA ANGLES

There is another aspect of viewpoint which is not so much and not primarily connected and set through the actual angle of camera to the subject, but has more to do with the way the story is told. Therefore it has very much to do with editing. It is the viewpoint from which the events on screen are narrated. Similar types of viewpoint we find in literature where stories can be told by an unseen observer, who knows everything but who never plays a part in the story himself, or by someone who is involved in what is going on and tells what happened to him and what he has seen.

As in literature also in film the viewpoint need not be the same throughout the whole story but can change even from scene to scene or shot to shot.

There are three types of camera angles: objective, subjective and point-of view.

Objective Camera Angles

The objective camera films from a sideline viewpoint. The audience views the events through the eyes of an unseen observer, as if evesdropping. Since this camera angle does not present the event from the viewpoint of anyone within the scene, objective camera angles are impersonal. People on scene seem to be unaware of the camera and should never look directly into the lens. Should a player look inadvertently into the lens, even with a sideways glance, the objective angle is no longer maintained. Most film scenes are shot from objective camera angles.

Subjective Camera Angles

The subjective camera films from a personal viewpoint. The viewer is placed in the picture, either on his own as an active participant, or by trading places with a person in the picture and seeing the event through his eyes.

The subjective camera may film the event in the following ways:

(a) The camera acts as the eyes of the audience to place the viewer in the scene.

The audience may be taken on a camera tour of an art museum and shown the paintings. Or the camera may dolly slowly along an automobile assembly line, giving the viewer a closer look at the process. A classic subjective camera example is the roller coaster ride in Cinerama. A similar effect is achieved when the camera films subjectively from a speeding bobsled, an airplane etc. In all these instances each member of the audience receives the impression that he is taking part in the action. The camera places him in the midst of the setting: he is riding the bobsled, flying the airplane etc.

Involvement generally is greatest when the viewer is startled or shocked.

(b) The camera changes place with a person in the picture.

The viewer may see the event through the eyes of a particular person with whom he identifies. The thrilling moving camera ride is always subjective, but static shots may be objective or subjective, according to the way they are edited.

When the audience sees a close-up of a person looking off-screen, it will comprehend, that with the next shot it is seeing what this person sees. The clock, the room, the park scene are then interpreted by the audience as being what the player sees in the scene. If the audience sees a falling person and then a shot taken by a camera dropped from a height on a shock cord, it knows, that it has traded position with the falling person. The spectator may experience the same sensations, because he is seeing the scene through the screen players eyes.

Providing the viewer is looking at inanimate objects, empty settings, or events in which people in the picture do not relate directly with the camera, the shot itself may be filmed in precisely the same manner, as if it would be, through editing, an objective shot.

Difficulties do arise however, when the camera replaces a player who must relate with other players in the scene. When ever other players in the scene look into the eyes of the subjective player, they must look directly into the lens. Normally the audience is startled when it is abruptly switched from an unseen observer outside the picture to a participant in the scene. If the switch is too sudden the audience, is unprepared and becomes aware of the camera. Such treatment can prove very distracting and may disrupt story-telling. Therefore these scenes need an introductory shot that the audience understands that the players on scene do not look directly at him as person, but at the player with whom he has traded place.

If an entire sequence, or a complete picture, is filmed subjectively, other difficulties arise. The subjective player may be introduced in a subjective shot, but when the camera replaces him, the audience must view everything subjectively, as he sees it, even his picture in a mirror his reflection in a window or a pool.

The camera must take the place of the player, it must move in a way to simulate his movements. This necessitates continuous filming with a mobile camera. The player (camera) may enter a room, look around, sit down, converse with another player, look at his own hand lighting a cigarette, look down at an ash tray, turn his head to look at a ringing telephone, get up and walk out etc.

The result of this continuous filming treatment is a great deal of useless footage between significant actions. This material often cannot be edited out because continuity would be disrupted. Furthermore the player or players in the scene must look directly into the lens when directly relating to the subjective player, as if they were looking into his eyes. On the other hand the audience does not see the subjective players reaction to other players dialogue or actions. Subjective player technique used all the time in a theatrical picture is not always effective. It is often boring because of the large amount of uninteresting material in between action, and because of the elimination of the subjective players reaction, i.e. because the audience sees only half of the normal interchange between players.

There are a few exceptions to the no-editing rule in subjective shots. Whenever the subjective player recalls an event in a flash-back orthodox editing may be employed. Subjective flash-backs may be presented in fragmented fashion, because a person telling a story need not relate to every single move but tell only the significant highlights. The normal form of editing may also be employed when in a subjective sequence the player is drunk or unbalanced. The audience will understand in such cases, that the player receives impressions, sees events through his mind's eyes as a series of individual images instead of a continuous happening.

(c) The camera acts as the eye of an unseen audience.

A typical example is the television newscaster who speaks and looks directly into the lens. Eye contact creates a personal relationship between performer and viewer, because each is looking directly at the other. Therefore also the man or women promoting a product in a commercial often speaks directly into the lens for greater attention and to attract the viewer personally. Also current events may present eye witnesses, who tell their story directly to the audience.

When filming news interviews, care should be taken to prevent the double look, in which the person being questioned shifts his look back and forth from the interviewer to the camera lens (audience). Either objective treatment, in which the persons look only at each other, or subjective treatment should be employed, not both simultaneously.

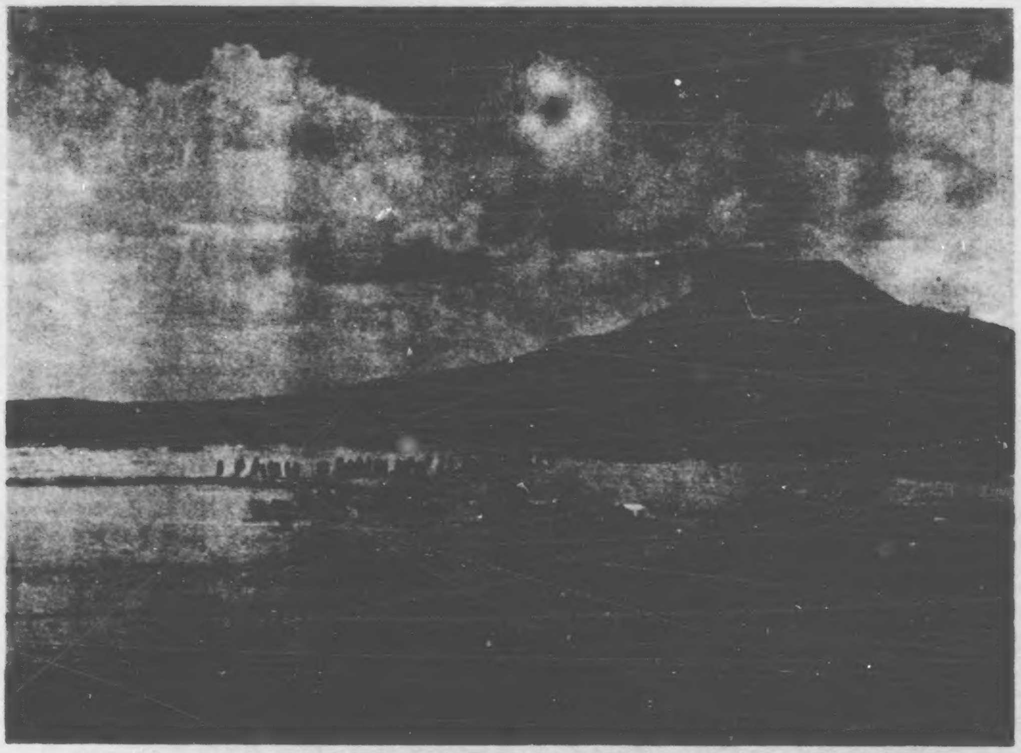
A personal relationship may also be set up in a dramatic film or a documentary through a narrator, who explains or interprets what is happening. The players in this case perform as if the narrator were not present, unless, in a documentary, they are called for an interview.

Point-of-View Camera Angles

Point-of-view, or p.o.v. camera angles record the scene from the viewpoint of a particular player. The camera is positioned at the side of that player whose viewpoint is to be depicted. The audience sees the event as if standing alongside the player. Thus the camera angle remains objective. An on-screen player looking at the player whose viewpoint is depicted, looks slightly to the side of the camera, not into the lens. So the audience is never directly involved as in subjective shots, where the other players look directly into the lens.

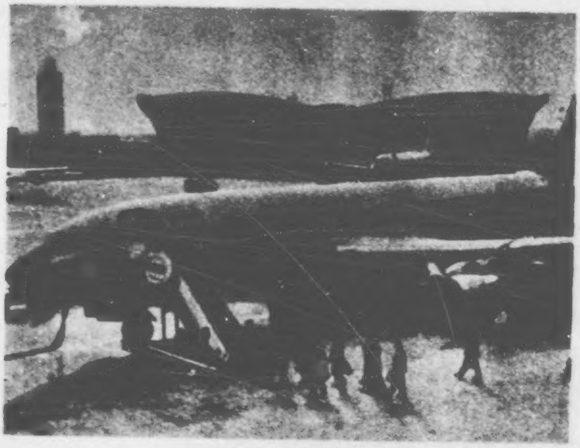
Point-of-view shots often follow over-the-shoulder shots, when a pair of players face each other and exchange dialogue. Any shot may become a point-of-view shot if it is preceded with a shot of a player looking off screen.

But a player should never look off-screen and then, after the cut to what he sees, the camera should never pan around and return to the player. This will jar the audience, because a person cannot see himself as he looks about.

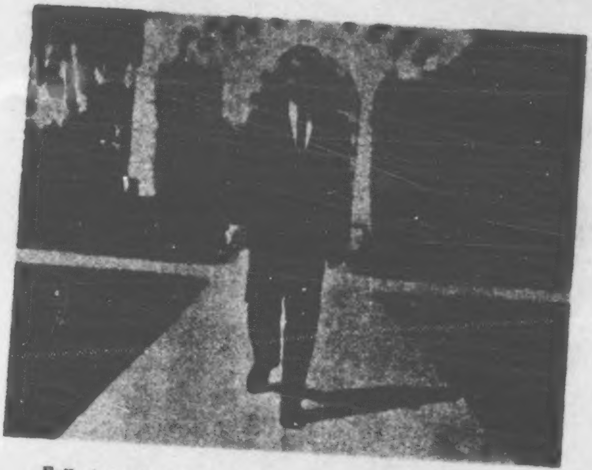


Extreme long shots may depict vast area from great distance, to impress audience with grandeur or scope of undertaking. Such shots establish geography of setting. A wide-angle static shot is best, but a pan shot may be employed if it increases in interest as pan progresses.

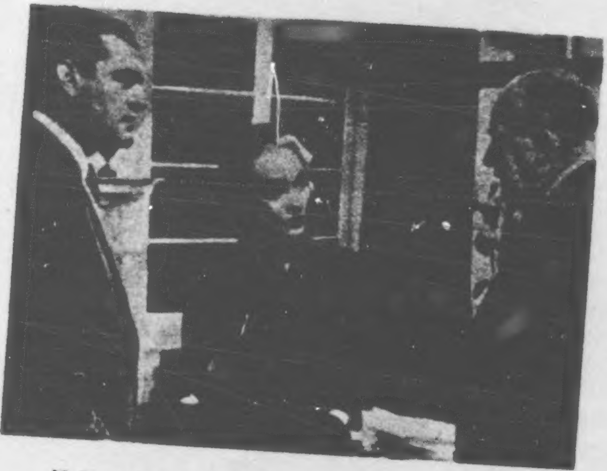
Long shots establish area of action and players' positions. Players' entrances, exits and movements should be covered in long shot whenever their location in setting is narratively significant.



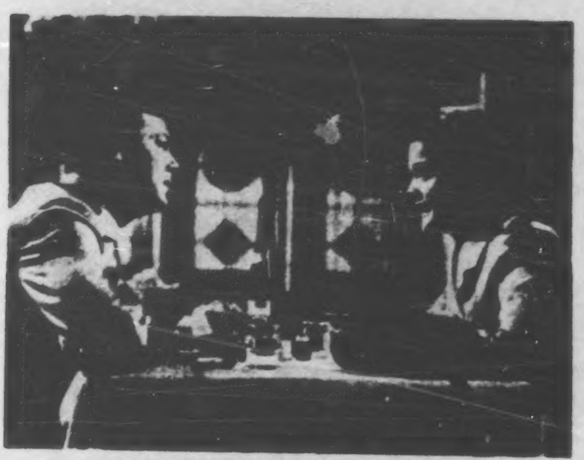
Long shots depict size of objects – such as this jet airliner – and dwarf players, who will be seen to advantage in later medium shots and close-ups.



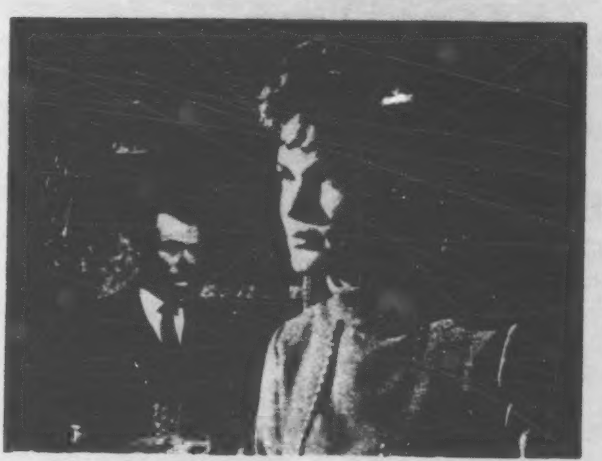
Full shots depict the full figure or the whole object but do not show the setting in its entirety.



Medium shots comprise bulk of theatrical and television films, because they position audience at middle distance. This is excellent for presenting events after long shot has established scene.

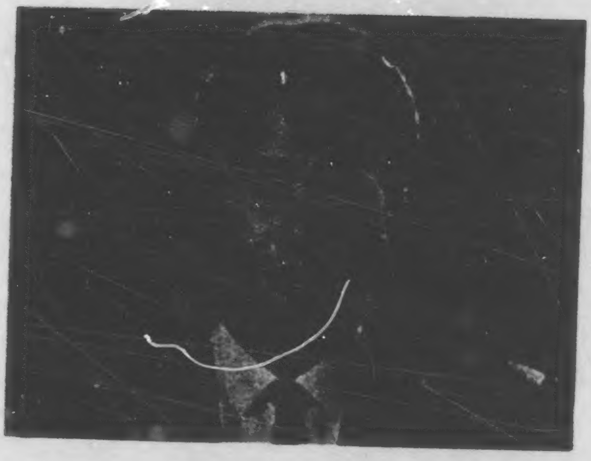


Typical profile boy-girl seated two-shots. Neither player dominates the scene from composition or lighting standpoint. Each player dominates in turn, as he or she speaks or perform an action that captures audience attention. Eye appeal is lessened in a profile shot.



Unique staging of two-shot by use of mirror. Player on right dominates scene because of larger image size, better position, three-quarter angling and lighting. Player in mirror captures audience interest because of reverse image, odd positioning and rear look toward foreground player.

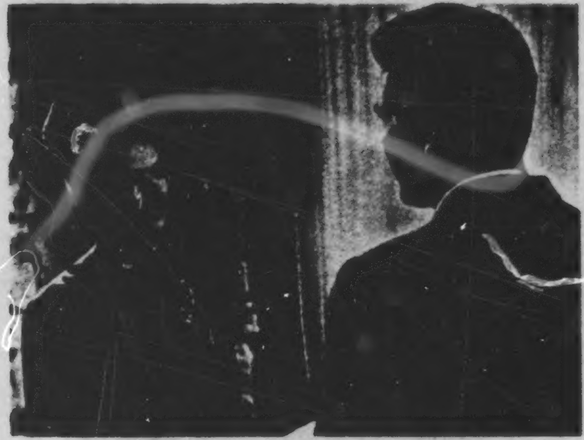
Medium Close-up



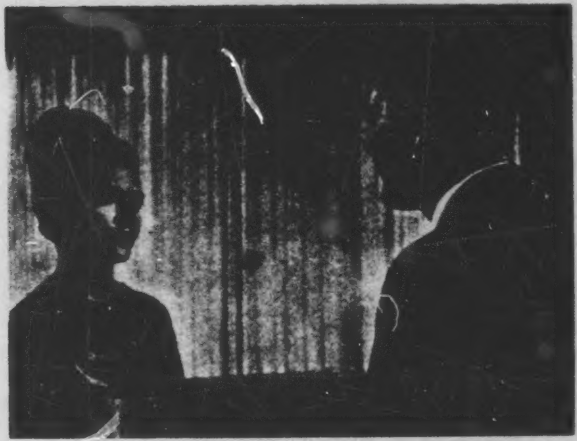
Head and Shoulder Close-up

Head Close-up

Choker Close-up



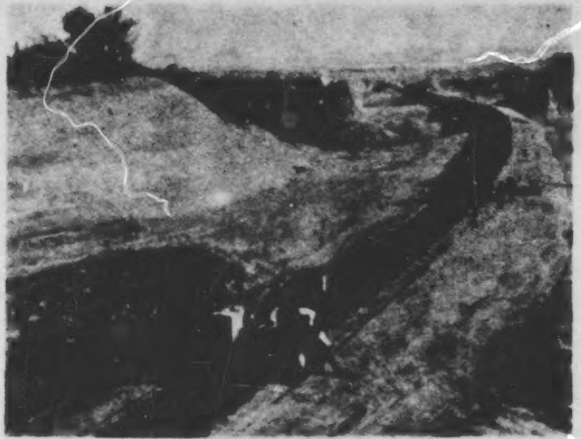
The foreground player, in an over-the-shoulder shot, should be angled so that his back and his side are seen from a rear three-quarter angle.



The camera is insufficiently angled on this over-the shoulder close-up. Note the tip of the nose extending beyond the cheek line. If the nearer player's features are visible, the scene becomes a two shot.

A seated person filmed from cameraman's standing eye level results in high downward single shot of top of head half-closed ...

eyelids and distorted view of subject. A much better shot results when filmed from subjects eye level.



Laying railroad rail bed is best viewed from above. High side three-quarter angles results in composition with greatest depth affect.

A high angle shot may be filmed to take advantage of particular framing – such as this over-the-shoulder shot of statue of President Lincoln.

Low angle shot of soldiers on firing range produce diminishing perspective, converging lines and dropped horizon – all of which contribute toward unusual shot.

Dutch tilt angle may be employed to shoot scene of distraught player in highly emotional state. Series of such scenes may utilize opposing tilts for greater effect.

CAMERA MOVEMENT

Camera movements are of two sorts. There are those where the camera moves on its mounting and those in which the whole camera and the mounting are moved from one point to another. These two types of movement may also be combined.

The camera has three axes around which it can revolve while standing in a fixed position. The panorama (pan) axis, the tilt axis, and the roll axis.

THE PAN

In the pan the camera revolves around its vertical axis and therefore moves horizontally from left to right or vice versa.

The pan is probably the most used of all camera movements, and it is also the easiest to misuse. The philosophy of "plonk-the-camera-down-and-wave-it-around-until-we've-got-it-all-in" has no place in any kind of filmmaking. So any kind of a panning shot should be considered carefully. Basically a panning movement has two characteristics. It reveals the object shown, in time with the movement, whereas for instance in a static long shot everything which is recorded is depicted in the picture from the beginning of the shot. Therefore a panning shot tends to guide the view of the audience more than a long shot, where the viewer more or less can pick out what he wishes to see.

Certain subjects may benefit from being revealed progressively, but in a scene which itself contains much action a pan may distract to much from what is going on.

Some subjects, a landscape for instance, may be too big to be filmed without panning.

Moving objects will also often need a pan to keep them in frame during the shot. While moving sideways the panning shot emphasizes the horizontal, therefore broad, horizontal compositions may be underlined since their structure corresponds with that of the movement.

If a pan is regarded as necessary there are a few rules to consider. A pan should begin and end with a strong, significant image. It is a bad cameraman who "pans from nowhere to damn-all". At the beginning and at the end of a pan the camera should pause for a few seconds, so that the editor can steady the effect of a pan and has a choice where to cut.

Unless for special effects, the pan should be slow and smooth. A pan that is too fast is not only uncomfortable to follow with the eyes, but will also have a pronounced flicker. A pan should not be followed immediately by a reverse pan i.e. one in the opposite direction.

If panning is necessary in order to follow a moving subject there are several points to notice.

At the beginning of the pan shot, the subject should move into the static composition. The same at the end, the shot should be held on statically for a short time, while the subject is moving out. This again provides the editor with a number of alternatives for cutting.

The movement itself should be picked up smoothly and the moving subject should be kept in a constant position in the frame while panning. Generally the frame should be kept slightly ahead of the subject, so that it (or he) moving into the picture and the audience already sees where it is moving to. So its position may be either at the side of the frame he is moving into, or preferably slightly to the left of the centre if movement is towards the right or slightly to the right of the centre if movement is towards the other way.

One should never pan against the direction of the main action, not only because this normally would be a very short pan but also because panning against movement increases the flicker effect.

A variant on the pan is the special effect known as the "zip-pan", "whip-pan" or "blur-pan", which uses a pan so fast as to blur any details of the subject, and conceal a transition from one shot to another. This may be effected by splicing in a short length of zip-pan footage between two shots, or else by ending one shot with a very quick pan away from the subject, and joining it to another shot which starts with a rapid pan to the subject. Care should be taken to match the speeds of the two fast pans, or the change from one to the other will become apparent.

THE TILT

In the tilt the camera revolves around its horizontal axis thus moving vertically up or down. Since the tilt is the vertical equivalent of the pan which emphasizes the horizontal, basically the same rules as apply to the pan apply to the tilt.

But there is one extra consideration the cameraman has to keep in mind when tilting. The light from the sky is stronger than the light from the ground, therefore it is normally necessary while moving up or down to open or close the aperture. Brightness can also be significantly different in a panning movement when a filmed moving object passes from bright sunlight to deep shadow. Since the exposure would suffer noticeably in one of the two lighting conditions, stop-pulling or a change of exposure during the shot becomes necessary.

Stop-pulling is a two man job. First the exposures in the different areas are calculated and noted by the stop-puller. The aperture is then set for the exposure required at the start of the shot, and the take begins. At the appropriate moment the stop-puller has to change the aperture to allow for the new exposure.

Since the aim is that the effect should pass unnoticed on the screen it should be done promptly but not too suddenly.

With tilting as with panning distorting effects of the lens, particularly wide-angle lenses have to be taken into account. As soon as the cameraman starts to revolve, the distortion is applied to the movement as well as to the form of the depicted subject.

THE ROLL

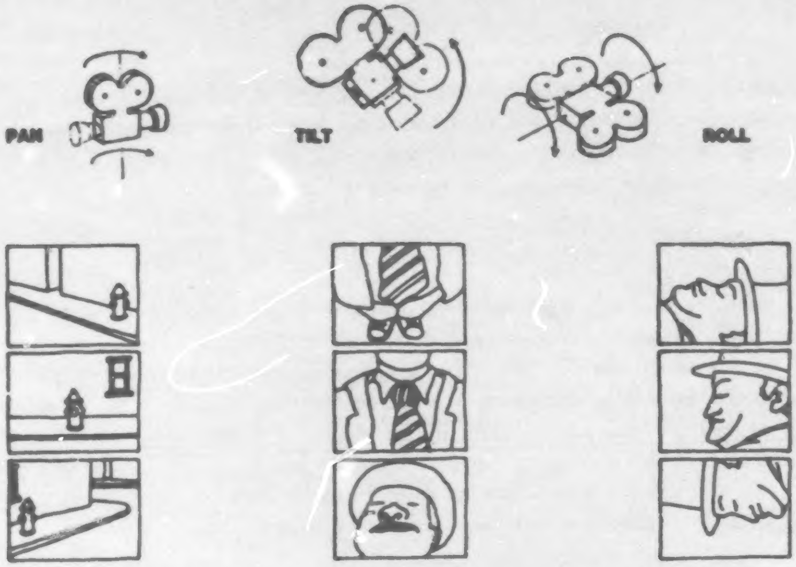
Pans, tilts and most of the mobile camera movements are common cinematic codes, and mimic common everyday movements. Rolls are relatively rare. We seldom tilt our head sideways and we cannot roll it around itself as the camera can do. The camera may start level, be then tilted to a Dutch angle to depict a weird change in events and return level when events return to normal. It may also be tilting from one side to the other in a rare shot which mimics for example the effect of an earth-quake. The movement of rolling the camera around itself is even more unusual.

TRACKING OR DOLLYING

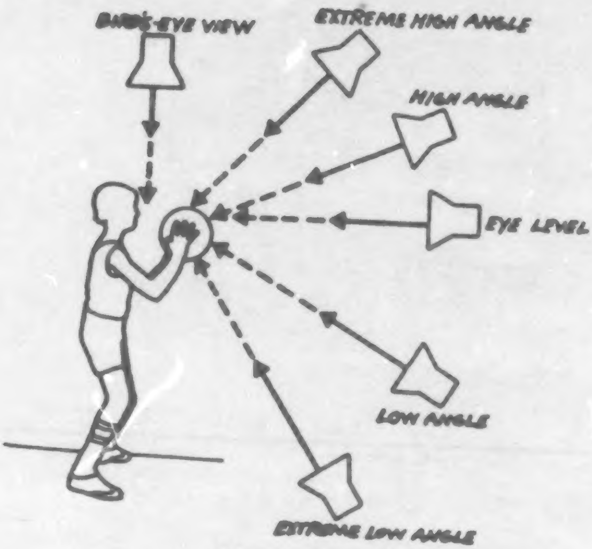
In the tracking or dolly shot the camera is moved in the horizontal plane, towards, away or around the subject. Often the camera and the tripod are mounted on a platform called dolly, which sometimes runs a temporarily laid tracks to keep the movement smooth. The effect of this camera movement can also be obtained by using for example a wheelchair, which bears the cameraman and the hand held camera, or, particularly for high speed exterior tracking shots, a moving car. When filming from a moving car, a hand held camera will normally give better, smoother results, than any form of fixed mounting, because the operator's body acts as a kind of shock absorber, which transmits less tremors. Although these shots look very jerky through the viewfinder, the speed of the movement if it is high enough, generally compensates for the jolting of the camera, and makes the result generally acceptable on screen.

CRANESHOTS

The crane shot is the vertical equivalent of the tracking shot. The camera is lifted or lowered on an elevating platform. If no proper crane

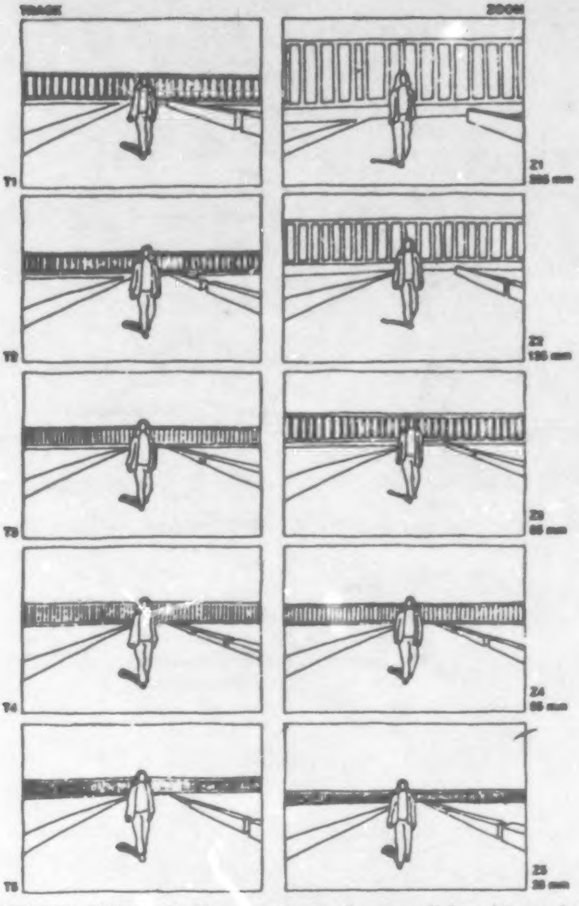


PAN, TILT, AND ROLL. The pan is by far the most common of these three elementary movements. The roll, since it disorients rather than providing new information, is least common.


BIRD'S-EYE VIEW
EXTREME HIGH ANGLE
HIGH ANGLE
EYE LEVEL
LOW ANGLE
EXTREME LOW ANGLE

THE ANGLES

The designation of each angle is determined on the basis of where the camera is placed in relationship to the subject photographed.



TRACKING VERSUS ZOOMING. These ten frames from parallel tracking and zoom shots illustrate the significant differences between the two techniques. In both series, the woman is walking toward the camera, covering a distance of approximately fifty yards between frame 1 and frame 5. The track was shot first, with a 55 mm lens. (Thus frames T4 and Z4 are identical.) The zoom was then shot to correspond to the track. The relationship between subject and background is dramatically different in the zoom. As the lens changes from telephoto (205 mm) to wide-angle (28 mm) focal lengths, depth perception changes from suppressed to exaggerated, and perspective undergoes a slight moderation as well. In the tracking shot, the distance between subject and camera is constant from one frame to another, and the building is far enough in the background so as not to change greatly between frames. In the zoom, the distance between subject and camera is constantly changing, and the relative size of the background building is magnified in the telephoto shots and distanced, or minimized in the wide-angle frame. Notice, too, that the angle of the shadow changes in the zoom.

is available the effect of the movement can be obtained by using an elevator, a fork lift truck, a public service maintenance lift, and so forth. A limited crane effect can be achieved if the cameraman raises himself from the squatting to a standing position while holding the camera. But this needs great steadiness and balance or the picture will come out of frame.

With these mobile camera movements the camera can change the area covered and the viewpoint recorded in one shot. The camera can shift the audience's attention, while moving in from a long-shot to a close-up and vice versa. Camera movement allows the subject to be filmed from a variety of angles, and to film in one shot what might otherwise have needed several ones. It continually changes the perspective of the viewer and significantly increases the illusion of depth. Furthermore camera movements tend to conceal the actual length of a shot, because something is constantly happening visually. A shot which, filmed static, would seem far too long, may well appear of the right length if movement of the camera is included.

ZOOM

The zoom shot is not strictly a camera movement, but because it has some resemblance to the tracking shot it can sometimes be used in the same circumstances. In the zoom shot, the camera is static and the focal length of the lens is altered, giving the effect on screen of approaching towards or receding from the subject. Therefore it mimics the effect of a tracking shot but it cannot do it precisely. In a tracking shot the actual perspective of the subject changes as the camera moves. In a zoom the camera is static, and only the apparent perspective shifts. Therefore in a tracking shot the spatial relationship between objects in different planes remain the same: We see a smaller area of the same image enlarged, so it appears to be closer.

When zooming, the focal length of the lens is constantly changing, and with it, the characteristics of the lens. So it shifts from the exaggerated perspective of the wide-angle lens to the flattened perspective of the of the telephoto. Secondly the depth of field decreases as the focal length increases, and, especially at wide apertures, the depth of field may dwindle to almost nothing.

In the track we move physically into the scene, the spatial relationships between objects shifts, as does our perspective. In a zoom there is no sense of entering into the scene, our perspective remains the same only the image is enlarged. So the effect is a strange quality: we seem to move closer without getting any nearer.

The zoom is often an inexpensive alternative to the tracking shot, but it should be used with caution.

THE HAND HELD CAMERA

In normal circumstances a tripod or any other rigid mount should always be used when shooting a film. Without any camera support, the image is likely to be very unsteady even more so on screen where any shaking is magnified and so becomes more apparent than it may seem through the viewfinder. In addition the hand held camera, being a one man operation, makes some refinements like stop-pulling and focus-pulling more difficult.

However, there are occasions, where the use of a fixed mount is impossible, either for technical reasons such as very restricted space, an extremely low camera angle, or the need for mobility and speed in shooting or to obtain special effects. Hand holding offers a range of angles, viewpoints and camera movements difficult to equal in filming from a fixed tripod. It also increases the intimacy between the camera and the filmed subject.

There are some considerable difficulties to overcome such as shaking, the main disadvantage of a hand held camera.

Forms of mobile support like a monopod, a shoulder pod or a body harness should be considered. If possible one can rest the camera on a solid object, like a chair or against a wall. If the camera has to be held with the hand alone, only practice can help to achieve a steady hand. The cameraman can learn to balance his body securely and to press the camera to the part of the body it touches. For movement with the camera, where the operator has to move his feet while keeping the upper part of the body still and smooth, requires a special gait. Moreover cameras require different techniques. With the Bolex the whole weight is borne by the operator's hand and the camera is steadied against the face; with Arriflex and Eclair the weight lies chiefly on the shoulders and the camera is balanced with the raised right arm. With smaller camera pistol grip hand supports are available.

The hand held camera is used most successfully in shots which themselves contain action and movement, and so distract the audience from an occasional wobble. The wider the angle of the lens, the less apparent will be a camera shake. Lenses over 50 mm focal length on 16 mm cameras are very difficult to use, extreme telephoto lenses of 100 mm or over are almost impossible. The reduced depth of field of long focal lenses also adds to the problem, by making it more difficult to keep a moving subject well in focus. Since hand held shooting by its nature demands immediate decisions of the cameraman concerning angle and exposure it is likely that more film footage will be used to get a fair amount of good shots, that with a fixed camera.

COMPOSITION

The previous section of the chapter dealt with the arrangement and position of the recording instruments, mainly the camera, in relation to the subject filmed.

The other aspect of the shooting process concerns the object itself. It is only in rare cases that the filmmaker does not have any influence on the arrangement and positioning of the various pictorial components, while preparing the shot.

The viewers' response to the visual image is conditioned by two elements: the movement within the picture, and the overall pattern of forms in the frame.

At first sight the arrangement of the various pictorial elements of a film picture does not seem to be so important, as for example in still photography, because movement is not only the greatest asset of motion pictures but also because of physical reasons; moving objects catch the eye more easily than static ones.

Nevertheless there are reasons, why the proper arrangement of the parts constituting the picture is important. Since in film the picture changes rapidly, and we tend to follow the movements on the scene, secondary details tend to escape our vision. Nevertheless we perceive the static components and their relation to the moving parts, and apprehend the meaning they convey and the atmosphere they create. Another reason is movement itself. Movements attract the eye, but unnecessary movement may also distract from the story told. Therefore the parts of a picture should be arranged in such a way, that only significant and desirable movements take place. Two types of composition can be distinguished, the closed form and the open form. It is important to note, that these two types do not refer to the spaces photographed or to the objects depicted. They relate to the patterns formed by the pictorial elements within the picture space, no matter what sort these elements are.

So, for example, a landscape can be depicted in closed composition. Since a landscape, as such, is bigger than any picture frame, it always extends beyond the part actually filmed. This suggests an infinite extension in any direction and tends to present an open form. If, on the other hand, it is framed, for instance, by a tree whose trunk closes the side of the picture and whose branches the top it can represent a closed composition.

Closed composition is achieved through an arrangement of forms that permits the audience to see the pictorial elements as a complete and self-contained pattern within the space of the frame.

Usually this pattern is simple in its structure and geometrical in shape. It often stresses the vertical or horizontal and can be reduced to squares, rectangles, trapezoids, triangles and circles.

An open composition points beyond the image frame insofar as it seems not to be complete in itself. The arrangement of its composing parts is not geometrical, seems to be accidental and is often organic (as opposed to geometric in character).

Both types of composition carry overtones of feeling. They create a certain atmosphere and foster subjective psychological responses in the viewer. Closed forms are constrictive, taut, heavy and formal, while open forms seem to be free, loose light and informal. Closed forms suggest rational calculation, while open ones convey spontaneity and immediacity.

Another factor which influences the perception of the composition is the way in which the eyes read the picture. While moving about in the scene or following action or dialogue, the movements of the eyes create transitional lines in space. So, a viewer's eye may travel in a curved line or a circle, while "reading" the grouping of the several players, it may draw a diagonal as it follows an airplane taking off or read a pyramide in the arrangement of two or three players. In many cases the imaginary lines structure the image more than the actual composition since this eye movement creates forms and patterns by itself and so creates structural relationships between the depicted objects.

ELEMENTS OF COMPOSITION

We are accustomed to see pictures as rectangles and, more often, as rectangles horizontally disposed. We have learned to accept the horizontal format of the frame so easily, that deviations from it gain expressive force and tension.

Format and frame in relation to several aspects of film has been mentioned already in the previous section.

Here is the place to state that the filmmaker, whether he uses conventional aspect ratio or a wide screen, need not accept the standard space and proportion.

The most drastic means to change the format of a film picture is by applying a mask or matte, which allows the transmission of light only on specific desired areas. With a mask the filmmaker can change the format into whatever shape he desires. Most filmmakers have tended to avoid such drastic variation because a change in format from rectangula horizontal to for instance vertical or circular, tends to interrupt special continuity, and confuses the viewer. It destroys the illusion of reality and makes the audience aware of the manipulative, artificial nature of film.

Therefore, it is more common to achieve a change of format through more subtle means which explain themselves in the story, either by lighting, and so illuminating only parts of the picture while leaving the rest in darkness, or more usual, through natural frames. Windows, doors, arches, mirrors and so on serve as framing elements to modify the rectangular space. A frame need not surround the picture fully. Often a partial frame, like a tree at the side, a street lamp, a portion of a large object such as an airoplane wing can be a compositional aid. Frames do not only intensify the whole picture, but can also be used to break up a large empty foreground or bare skies. Partial frames can assist in creating a certain atmosphere and can add perspective and depth.

Since frames are used to alter the format, they should not merge with the main subject. Therefore similar tonal values, similar colours or similar light effects will destroy the pictorial effect. Out of the same reason frames should generally be in focus.

Compositional lines may be actual contours of objects depicted or the imaginary lines drawn by the eye.

In the part on perception some of the meanings conveyed by lines were already listed.

The "Hollywood codex" lists more of these interpretation patterns, but it seems doubtful if straight line really suggest masculinity and strength and softly curved lines femininity and delicate qualities. But it is true, that straight unbroken lines are "read" faster by the viewers since they do not impede the progress of the eye movement. Therefore they may convey qualities associated with speed.

Softly curved lines slow the eye speed and tend to create a leisurely, deliberate pace. A receding or diminishing curve also suggests distant space and carries the eye into the picture. (a river or stream).

Unopposed verticals, beginning at the bottom or ending on the top of the picture appear to extend beyond the frame. They not only lend depth to the picture and create perspective, but also go beyond the frame and lead to an open composition. Lines like horizontals and verticals which reinforce the limits of the picture frame lead to a closed composition. Because of our reading habits, long horizontal lines suggest quietness and restfulness as do repetitious vertical lines, like those drawn by the eye when it follows snow flakes or rain drops.

Since the picture frame normally contains only one picture, real lines should not divide the frame space into equal parts. So neither strong vertical nor horizontal lines should be centered nor should the frame be divided into two equal parts with a diagonal line from one corner to the other.

All objects, whether natural or man-made have forms. Physical forms are easy to recognize. Forms created by the viewers eye movement are not as easily identified. While grouping people, furniture, objects and so on, the cameraman should take invisible forms that the eye composes into account.

Basically two forms can be distinguished: compact and closed forms which cause the eye to continue from point to point without escape, like circles or triangles, and those which have a certain flexibility, even suggest informality, but whose spatial aspects are designed enough not to let the eye go astray, like cross compositions, or ray like forms.

Besides holding the viewers' attention through shape, a triangular form suggests strength, stability and solidity. A tall, thin triangle, for example, a tree, is related to the vertical, short squat triangles are related to the horizontal. Mountains are composed of a series of triangles, which convey stability already through their form.

Triangle compositions are very useful for grouping people, because the dominant player can stand out easily through arrangement. In such compositions a reverse triangle with its apex at the bottom may also be used although it lacks the stability of the pyramid.

Like the triangle a *circular form* also tends to tie the eye and hold the viewers' attention to the center of interest. The *cross* is a more open pattern, but still designed enough to keep the audiences' attention "on line". It is one of the few compositional forms that may be centered without letting the picture fall apart in four pieces. For cultural reasons, and because its four arms radiate in all directions equally, it inspires a sense of unity and force. Radiating lines give the eye a rhythm of back and forth movement but always lead back to where they are centered. Therefore the centre of interest should be located near the hub.

Various *L-shaped forms* suggest informality but provide at the same time a base and a side limit through the combination of horizontal and vertical.

Shape refers to the spatial aspect of an object, its contours. Form is related to the pattern the contours suggest. Mass is the *pictorial weight* on an object, an area, a figure. Mass in this sense can consist of one single unit in the picture frame like a large head in a close-up, it can also be one single unit which stands out against the other elements of the picture, like a mountain, a ship etc. and it can also be several objects grouped together in such a way that they form a single compositional unit. Masses tend to dominate the picture by conveying a sense of cohesiveness, stability, and through their contrast to the other elements in the picture.

Strength is added to an isolated mass if it is separated from its background by contrast - dark mass stands out against a light background, a light mass against dark surroundings. A large mass will dominate the scene also if it is contrasted with one or more small masses. The size of a mass can be increased in relation to the picture frame through choice of the camera angle, focal length of the lens and placement in the frame. The pictorial weight of a mass can be increased through its colour, preferably primary or highly saturated colours.

To compose movements and their direction carefully is particularly important in filmmaking, because movements as such attract the viewer's eyes easily. This is the difference to still photography which can only suggest movement. Motion picture can suggest and depict movement. Movements of the moving objects in the scene are followed by the viewer's eyes and so transitional lines are drawn. These transitional lines can be compared in their meaning or the mood they convey with the compositional lines already mentioned. Horizontal movements suggest travel, momentum and displacement. Again, because of our reading habits, left to right movements are easier to follow and appear to be more natural, whereas right to left movements are stronger, because they are 'against the grain'. Ascending vertical movement suggests aspiration, exhalation, freedom from weight and even happiness and elevation. Descending vertical movement suggest heaviness, danger and even destruction. A diagonal movement is strongest and most dramatic because it acts against the normal frame pattern. A lower-left-to-upper-right diagonal progression should be used for ascending, an upper-left-to lower-right progression should be employed for descending movements, for example the climbing up or down of a mountain.Pendulum motion suggest monotony,relentlessness or nerviosity.

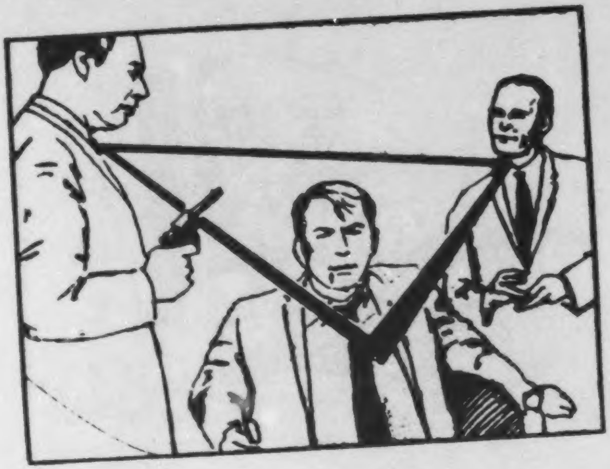
Movements may change during a shot or a sequence of shots, to match the changing character, mood or tempo of the action. This is not always as easily achieved with compositional lines. Interrupted movement, or movement that changes direction, also attracts greater viewer interest than continuous movement or movement in a constant direction. Movement towards the viewer is more interesting because it increases in size.

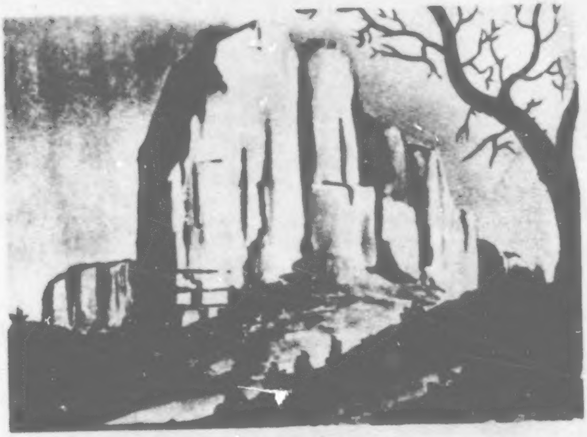
The arrangement of all the different compositional elements results in a picture which will either look balanced or unbalanced. Balance is a state of equilibrium. If all forces are equal, or compensate each other, they are said to be "in balance". Balance in the strict sense of the word is concerned with physical weight. If both sides of a pair of balances carry the same load, they are balanced. In a picture, balance is the result of the psychological weight of the different elements out of which it is composed. The illustration with the pair of balances still holds, both sides of the picture can be compared to the two sides of the scale, but it is not only the law of gravity which rules here. The psychological weight is influenced by gravity because we tend to associate a big mass with heavy weight, but its main component is the relative eye attraction of the various compositional elements in the picture. Each element attracts according to its size, shape, tonal value, colour, movement, direction it faces, contrast with its surroundings and placement in the frame. Therefore it is possible to counteract the real or assumed weight of the various elements with those other characteristics which have to do with their eye attraction.

A properly balanced composition is subconciously agreeable, because the various elements are combined in such a way, that the whole picture looks "right". A picture which is unbalanced upsets the viewer, gives him an uneasy feeling, because it disturbs his sensibility. Though there are occasions when a filmmaker wishes to disturb his audience, in general a scene should be composed in such a way, that the laws of pictorial balance are observed. It is easier to achieve pictorial balance in a static shot, but in these shots balance is also more necessary because the audience has more time to perceive the various compositional elements and their relation to each other. In scenes which include movement the movement itself will distract the viewer enough to let small compositional inadequacies to go unnoticed. Here, pictorial balance is a series of pictorial compromises based on key positions of players and of pauses in the action, when compositional elements are at rest.

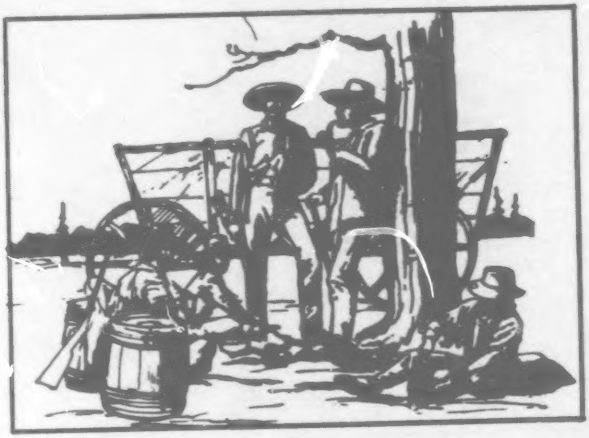
Balance in a film picture can be of two sorts: it can be formal balance or informal one.

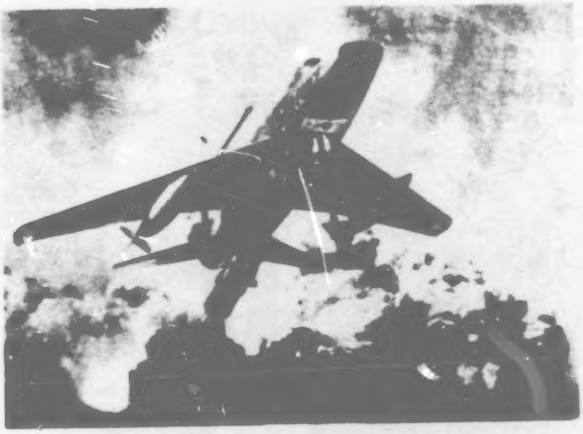
A reverse triangular composition – with apex at bottom – may also be used to compose three people. While it may be weaker in form, it is an excellent choice in this instance, because standing players dominate centered player. Composition would be weakened if player at right were absent.



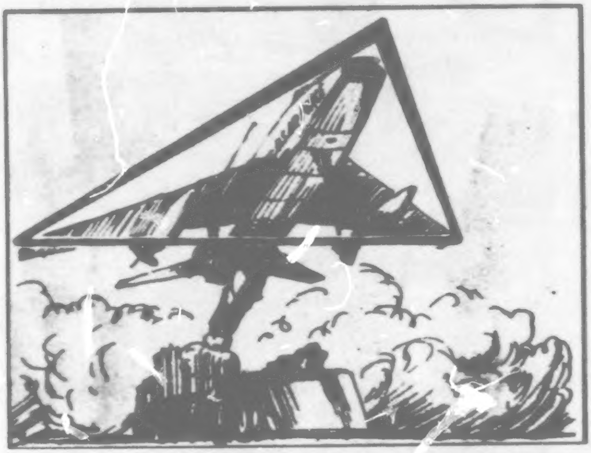


A mass may be a single pictorial element – such as a mountain peak – or it may consist of closely grouped figures that appear as a single composition unit. A large mass captures viewer's attention through the power of its heavy pictorial weight.

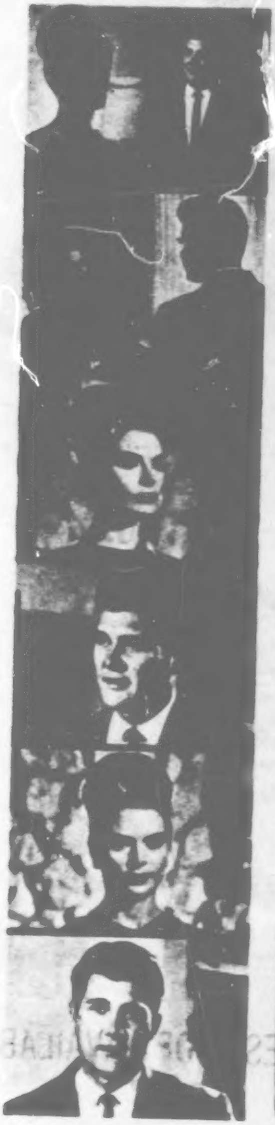




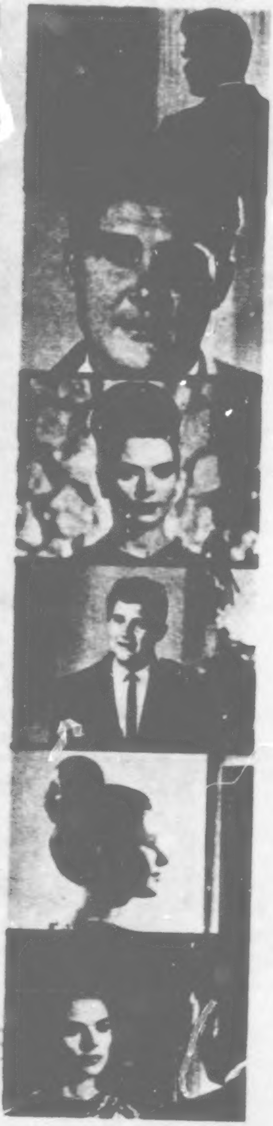
Lower-left-to-upper-right diagonal motion should be used for ascending movement. Angling this mobile-launched jet fighter, so that it moves across the screen in this manner, results in a dynamically effective shot. If this shot were filmed from the opposite side, it would depict the aircraft with an opposing transitional line which should be used for descending motion.



CORRECT
EYE SCAN



INCORRECT
EYE SCAN



When both sides of the picture are *symmetrically* composed, i.e. formal balance results. The most prominent example is the classical Hollywood profile two-shot, in which two players sit or stand facing each other on opposite sides of the picture frame. None of them is dominant, both are equally well placed and lighted and so equally important. The viewer's eye is attracted in turn as each of them speaks. Formal balance is usually static and lacks force and contrast. When both sides of the picture frame are different in pictorial attraction if the weight of each side is not of the same kind though of the same weight, the picture is composed *assymetrical* and *informal balance* results. In an informally balanced picture a dominant figure or object provides the centre of interest. In contrast a secondary figure or object of equal compositional weight can be placed on the other side of the frame. So, for example, a smaller opposing compositional element can compensate for its size by additional weight through its location, shape, brightness, movement or colour value. Informal balance in close-ups can be achieved when only a single player is in the frame - by placing the head slightly off-center, so that slightly more space is provided in the direction in which the player looks. The look carries sufficient weight to compensate for the heads off-center position. In this way, the on-screen player is balanced with an invisible off-screen player. In a two-shot for example, one player can be favoured over the other with brighter lighting, a better angle, a brighter costume, better separation from the background. Inforamal balance in a shot conveys a sense of dynamic, because it stresses the difference and the contrast of opposing compositional elements.

The frame is the base of all compositional elements. The centre of the picture is nearly neutral. The nearer to the side of the frame an object is placed, the heavier it will appear. Therefore a light weight element may be located further away from the centre, while those of heavier weight should be positioned closer towards the centre. Since most viewers' eyes automatically move to the right, the right side of the frame can attract and hold more attention than the left side.

The upper part of the picture carries a heavier psychological weight than the lower part, so an object placed higher in the frame appears to be heavier. Therefore a subject which should dominate the scene should not be placed on the same horizontal line with the lesser-weight opposing element, but should be located preferably slightly higher in order to attract more attention. A large object in a static shot will carry more weight and will tend to dominate the picture regardless of other factors. Also a regularly shaped or compact object will appear heavier than an irregularly shaped or loosely joined one. An isolated object will also catch the eyes very easily. But a peculiar or intricate object may appear heavier, because it generates additional interest. A bright object will possess more weight than a darker one. A high-key, light-toned object appears to advance towards the viewer, whereas a darker one seems to recede into the background. A black area therefore must be larger than a white area to counterbalance it. Also warm colours such as red seem to be heavier than cold ones, like for example blue. A moving object catches the eye more easily than a static one regardless of size. So large static object, such as a mountain, can be counterbalanced by a small moving object for example a car, on the other side. An object moving towards the camera becomes progressively larger and so carries more psychological weight than a diminishing object moving away.

EYE SCAN

In the chapter on perception, the saccadic movements of the eyes as they search the picture for its meaning were already mentioned. In composing a scene the film maker is not only concerned with this eye movement within one picture, but should take even more into account the saccadic pattern with regard to the succession of images. The frame the audience looks at always remains the same, but what it sees in it changes. If for example the location of a depicted object in the frame differs from shot to shot, the viewer's eyes will have difficulties to find it. Again it depends what effect the filmmaker wants to create. Normally in a two shot and subsequent close-ups for instance, the audience should have no difficulties to follow the players.

Therefore the position of the players in the frame, their relative height, the direction of their looks should be composed in such a way that the viewer's eyes are kept on a level or may look up and down if one player is higher and so be directed back and forth with each cut. This is also true for long shots, followed by closer shots. Viewers' eyes may be led to the centre of interest in a long shot. This area should then be presented in approximately the same part of the frame in the following closer shot. Otherwise the viewers' eyes will make a decided jump in trying to find the centre of interest once more. This eye positioning can be easily checked on Moviola or other editing device. A mark should be made on the portion of the frame where the eye is attracted. Then the film should be rolled a frame or two to the next shot, and a similar mark should be made. In a series of correctly framed and composed scenes the eye will scan approximately the same area and be directed towards the same part of the frame in the following shot, or will scan back and forth in a two shot.

But there are occasions when the centre of attraction should change. A twist in the story, a surprising move on the part of a player may be brought in suddenly which causes the viewer's eye to shift abruptly to a new area within the frame.

It is more important to take the saccadic pattern of the eyes into account when working with a large screen. On small screen projection and on television, the eyes need less lead since they can encompass more or less the entire area of the picture frame.

CONTINUITY

A motion picture is a record of an event in fact, fiction or fantasy. In its simplest form the event is depicted as continuous action in a stationary shot of for example a person walking from one point of the screen to another. In this case the setting and the action are uninterrupted, space and time is structured only by the movements of the body of the walking person. But normally a film is composed of several shots which make up a sequence and the series of sequences add up to the complete picture.

The different images reproduce real life or present a make-believe world, but the audience will only accept the illusion, if the flow of the visual images is locical and coherent. The shots have to be arranged in such a way that the action of a particular thing in space or the movement of the film through time seems uninterrupted. The succession of the individual shots needs to be continuous, i.e. each shot has to develop out of the preceding one and has to merge with the next one. This does not imply, that action should flow smoothly across every cut. For a number of reasons - to provide information, to intensify the visual excitement, to inject a visual shock or to modify the rhythm, the filmmaker may not wish to maintain smooth continuity in either the movement from shot to shot or the continuous action. But good continuity does mean that the audience need not have to figure out where the camera has suddenly shifted or why an unexplained change has occured in players' action. If the audience loses track of what is happening, the events depicted on screen do not appear to be real or believable, and if this illusion is shattered, the viewers may lose interest. In this way, good continuity is the most important cinematic device. Continuity is the quality which holds the pictures together and which allows different shots and sequences to appear as a whole.

Continuity has very much to do with editing. But if the editor does not get the right pictures to put together, the motion picture will be a jumble of animated snapshots which may contain movement in themselves, but which cannot be arranged into a series of fluid and merging images.

Therefore the director and the cameraman must think in terms of sequences and every shot should be regarded as an integral part of a sequence. Continuity can be divided into three main categories: Continuity of time, continuity of place and continuity of action, but there are two other areas which are important as far as visual continuity is concerned: Photographic continuity and continuity of lighting.

Consistency of the texture of the visual images is essential if the sequence is to flow smoothly and be accepted as being of one piece. Therefore, if no special deliberate visual effect is sought, the fimstock should be the same throughout a scene or even a sequence. This is even more important when working with colour filmstock, because in addition to variations in grain structure and contrast as in b/w stock, also colour rendering can be very different between one stock and another. Lighting also must be consistent from one shot to the next. Even a small spotlight apparently disappearing between shots will alter the visual nature of the shot. It is therefore useful to draw up a diagram of the lighting set-ups. This will help to contain the visual identity of the shot not only when the take has to be shot in more than one session, but also in setting up possible retakes.

All aspects which give the illusion of continuity interact, and all play a part in the overall continuity of a specific film.

CONTINUITY OF TIME

Screen time is very rarely the same thing as real time. Motion pictures can create their own time to tell their particular story.Film evolves in time and the succession of the images is set by the filmmaker.

The time aspect in film is twofold. Actual time moves forward only and it moves at a certain pace.

A motion picture can go anywhere in time, it need not stay in the actual time which is always the present, but can go back into the past and forward into the future. And it moves at the pace the filmmaker desires. Time may be compressed or expanded, or it may even held constant as long as is desired.

But the filmmaker has no difficulties in presenting, nor the viewer in recognizing in a continuous series of connected events arranged chronologically, that they have taken place in the past or are taking place in the present, or are expected to take place in the future, or are only taking place in the imagination of one of the players. So motion picture time may be divided into four categories: *present*, *past*, *future* and *conditional*. Furthermore a film may not stay in one of these times, but may depict events as happening in the present, and then *switch* backward or forward. The localization of time can be indicated verbally in titles or in voice-over narration. Calenders, news-paper materials or similar devices may also be used to indicate a particular time. When the specific time is not crucial, the viewer will infer time from the context, action, costumes, setting or speech. Whichever way time is portrayed, its handling must be easily comprehended by the audience.

The actual filming of the shot is normally not markedly different, if the events are taking place in the present, the past or the future. The "see it now" manner of present time continuity gives more life to the material presented and involves the audience more. This is particularly important in historical subjects, where the outcome is already known to the viewer. This manner of presentation as if it occurs right now and before the eyes of the spectator is also helpful in cases where the material presented itself is difficult or dry as in many documentaries or scientific films. Conditional time continuity is a somewhat different case, since here the audience should not believe that what it sees has, is or will really happen, but should only understand that imaginations or thoughts of persons are depicted.

Therefore it is more common here to present the material in a different form. But time in a film need not move only in one direction. A motion picture may employ one or more times, singly or in combination. These time switches are normally achieved by flashbacks, switches from present to past, or by flashforwards, switches from present to future. With a flashback or a flashforward the filmmaker sets up a relationship between events taking place at different times. After haveing established a moment in time the flashback or flashforward is introduced.

Flashbacks may portray an event which occured in the past, either a portion of the story not previously shown, the version of a character of what has happened (or, in several flashbacks the different versions of several persons involved in the story). A flashback can be employed to clear up a plot point or the development of a mechanical process. Flashbacks can also be used as a structural device to add interest and complexity to a story which could have been told in a chronological order. These are internal flashbacks; they are directly related to the events of the film and explain them. A flashback can also be external and not directly related to the film just told, so for example it may provide background material or a comment of the filmmaker about the events shown on screen. A *flashforward* is the opposite of a flashback. It moves ahead into the future to describe events that will, may or could happen - and then returns to the present. A flashforward can depict events imagined by a character in the present story, it may show an industrial projection, or it may predict developments if for example a certain technological path is followed.

Time in film cannot only move in another direction than time does in reality, but it also may move in its own pace. Time may be expanded or compressed, speeded or slowed, or it may even be held constant for as long as desired. It is possible to prolong a moment to heighten its impact and significance, by repeating the action several times. Or a sequence may be intercut with other images, and so extend real time of say, two seconds into a sequence which lasts, for say, two minutes. But normally it is the necessity to *shorten real time* which causes continuity problems. Most actions will be too long to show them in their entirety. There are a number of standard devices to condense time in film, though it should be added that there is a developing acceptance of jumps in screen time, and less elaborate measures for shortening time are increasingly used.

Fades and dissolves can easily do away with long sections of time. Certain effects of sound editing can also be used to cover broad areas of time.

Time can also be reduced merely by showing the beginning and end of the action. This is not as easily achieved as it sounds. A cut from beginning to end, omitting the middle, must be accompanied by a radical change of angle and composition, in order to distract the attention from the fact, that the action is not continuous. The change in angle can also be reinforced by a move from a close-up to a long shot or vice versa. If the change in angle, composition and maybe size of the images of the two shots is not fundamentally different, the result will be almost inevitably a jump-cut, which will disrupt the flow of the sequence. Therefore, very often, a cutaway shot is placed between the shot which shows the beginning of the action and that which shows the end. So both shots are separated enough to let them appear markedly different. To condense time, especially time which has elapsed between two sequences, sound or musical devices can also be used. The whole problem of continuity is closely related to editing, and more on the subject will be discussed in the chapter on editing.

CONTINUITY OF PLACE

In general the audience should always feel sure about the location of the action. This is so not only because otherwise the viewer may feel confused, but more so because viewing habits have formed expectations and lead to assumptions.

So, if a man goes through a door, the next shot will tend to be taken for the place into which he has gone. On the other hand, if a particular aspect of a location is shown, the audience will assume, that the action has moved to another location, if the detail has not been established as part of the general scene. Therefore it is normally useful to start with a general establishing shot of the whole location, so that the viewer can locate all the component parts. If detail is shown, it is important to use the correct eyeline. This has the advantage, that particular objects seem to be on locations, where they are not in reality. So, when Tarzan fights a panther, he is very seldom at the same place as the animal. All shots of the panther are taken from the angle at which the audience supposes Tarzan would see it, and all shots of Tarzan are taken with him locking where the audience assumes the panther to be. Intercut, these shots will seem to show Tarzan and the panther at the same place at the same time.

The audience also normally should not be distracted from the action by apparent discrepancies in the visual presentation of one location in several shots. Mistakes or negligence in this point are very difficult to overcome by the editor. So, details of settings must be absolutely consistent from shot to shot if the results are to be intercut. This problem is particularly severe in the case of retakes. A parked car visible in the background must remain there for all shots, unless it is seen driving off. The same consideration applies equally to every detail of dress, make-up, personal appearance as well as to every minor property on the set. A typical lapse that can occur in this field are shadows at different angles, or shadows which appear or disappear from shot to shot, due to different lighting conditions. It will be very difficult to cut the different shots together in such a way, that the scene or sequence appears to be continuous.

But only in rare cases the filmed events take place on only one location. Normally a motion picture takes its audience instantaneously to many different places. It is also very often necessary to shorten and condense events in regard to place. So normally a journey is not shown in its entirety, only certain highlights are presented. As in the case with time, the audience should receive the impression of viewing events in their entirety. Therefore, like a time lapse, a change of locale must be explained either within a sequence or between sequences, and several devices may be employed to bridge space.

The devices are very much the same as those to bridge time lapses. Pictorial devices would be titles, which show the name of the place, fade-in's and fade-out's. Also dissolves in which one scene blends with the next, or wipes, where one scene seems to push another scene off screen can be employed. To bridge or explain changes in place, sound devices may be used, either in the form of narration or sound effects, like the whistle of a train, or music. There are many other transitional devices, but all of them should be employed as a means to a specific end and should therefore not attract undue attention to themselves and distract from the story.

CONTINUITY OF ACTION

This is probably the most complicated aspect of continuity, and the area where mistakes are most easily made. Continuity of action is basically the construction and fitting together of several successive shots in such a manner that the audience assumes that the action portrayed in them is continuous. Since the lens of the camera is the only and the single viewpoint of film, continuity of action depends very much on the skill of the cameraman of placing the camera in such a way that movement appears consistent from shot to shot and that eyelines are tied up correctly. If a complete film would be photographed in one single shot with the camera resting on one place, as in the early days of film, there would be few problems with regard to the continuity of action.

But since a film consists of many different and distinct shots which have to match together continuity is not always easily achieved. There is no better way for a cameraman to win the respect of a film editor than to deliver footage which will cut together without the need of optical flopovers and other reversing editing tricks.

Good continuity of action rests on two basic elements: the expectations of the audience formed by viewing habits and the picture frame itself. If a man is walking left to right on the screen to reach somewhere, the viewer will assume that he is going back to his starting point if the next shot shows him walking right to left. If close-ups of two people are intercut the audience will assume that they are relating to each other only if each of them looks in the direction where the viewer supposes his partner is situated. Continuity of action is the spatial relationship of persons or objects, not as they are, but as they appear on screen. It is the direction in which a person or object moves or the direction in which a person looks. As already indicated in the examples, there are two types of screen direction, dynamic screen direction, where bodies are moving and static screen direction, where bodies are stationary.

DYNAMIC SCREEN DIRECTION

The movement of persons or objects on screen can be either constant, contrasting or neutral.

Constant screen travel depicts subject motion in one direction only, left-to-right or right-to-left. Once travel direction is established on screen for a particular travel pattern it should be maintained. If a cut suddenly depicts the person or vehicle moving in the opposite direction to that previously established, the audience will receive the impression, that the moving subject has turned around, and is returning to its starting point. For example a story which involves a train journey: Even if the shots show the activity inside the train, all shots which show the train moving should depict it as moving to the same side of the picture frame.

Camera angles on the train may be varied, long shots of the train may be intercut with close-ups of the wheels, but the direction of the movement must not change, otherwise the viewer will get the impression, that the train suddenly is moving backwards. For the same reason cuts from the exterior of the train to interior shots, should be taken with the camera shooting from the same side of the train, so that the view through the window shows the same direction of movement. Later, when the scene is established, and the interior sequences continue, the camera angles may be varied.

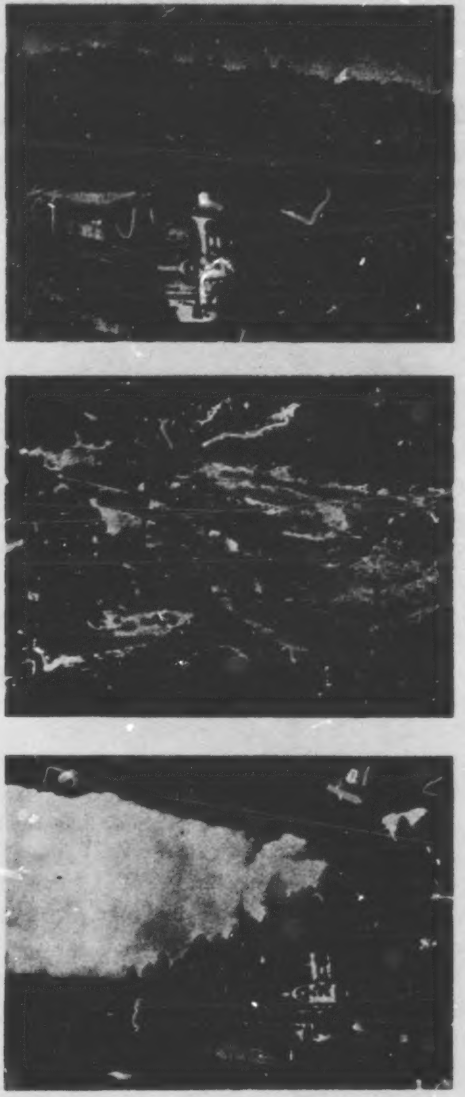
Contrasting screen travel depicts subjects moving in opposite direction. Either when depicting an object going or returning, or whenever two subjects must be shown moving towards each other. So for example a subject may go and return, perhaps from his home to town and back again. If home to town has been established as left to right, and town to home as right to left, all shots, whether long shots or close-ups even of his horses' feet, should maintain this direction. If later a group of men are shown leaving town and heading to the left, the audience automatically will assume that they are going for the subjects' home. Travel direction for both coming and going must be consistently the same, however, many times the action returns to the same locale. This consistency of screen travel is as important in documentary films, be it airplanes shown leaving and returning, be it raw materials arriving at plant, or be it a production line in a factory. Camera angles and types of shots may vary but the established directional pattern of coming and going should be maintained throughout the picture.

Contrasting screen travel is also employed to depict opposing subjects moving towards each other. If opposing screen movements are edited in an alternate pattern, the audience will assume, that the moving subjects will meet or clash if not informed otherwise.

Neutral screen direction depicts moving subjects travelling directly towards or away from the camera. Since neutral movements are non-directional, they may be intercut with shots showing movement in either direction. But head-on tail-away shots are neutral only as long as the moving subject remains centered in the frame, i.e. does not leave the picture frame on one of the two sides. It can leave the frame on top or on bottom, as in high or low angled shots, where the moving object travels out of view under or over the camera. Directional travel also remains neutral, if groups of objects travel towards the centered camera and leave the frame on both sides or enter the picture frame from both sides to meet and move away from the camera, which is placed in the center. However, a head-on shot may begin neutral and then exit one side of the picture to match-cut with a following directional shot. In the same way a tail-away shot may enter one side of the frame and then become neutral as it moves away from the lens.

Neutral shots provide visual variety in a series of constant left-to-right or right-to-left shots. They also emphasize depth in the picture frame because the moving images increase or decrease in size. Neutral shots can also be used deliberately to switch screen direction. Neutral shots are also useful to distract the audience from directional miss-matches. If in a sequence which shows constant screen travel, one or more shots have been taken with movement to the wrong direction, a neutral shot can be used to cover the change in direction.

DYNAMIC SCREEN DIRECTION



Established screen direction should be maintained throughout a travel sequence, regardless of camera angles.

Contrasting screen travel may be used to show subject going and returning.

Left scene depicts group travelling from home to town.

Group at right is returning home — in opposite direction.

If head-on subject exits frame — proper exit side is important to preserve established screen direction. Rider, above, must exit right side of frame in order to travel left-to-right in next shot below.

ACTION AXIS

To maintain directional continuity may sound simple and it is when movement is square on to the camera. But when the movement is cross-screen and moreso when it is diagonal, confusion may arise as to where to place the camera for the next shot.

A simple method for establishing and maintaining screen direction is by use of the action axis. Subject travel may be considered as a line on a map, an imaginary line drawn by a person while walking down a hall, a vehicle while driving on a road or a plane while flying through the air.

This travel line is the action axis. If all camera set-ups are positioned on one side of this line, screen direction will remain the same throughout a series of shots, regardless of camera angle. Directional movement will be constant, when the subject always moves in the same direction, contrasting, when the subject moves into the opposite direction. The relationship between camera and subject movement remains the same providing the camera does not cross the action axis. If on any new location a new axis is drawn and the camera stays on the same side of the axis as in the previous shots, the proper travel direction will be filmed automatically in all the shots.

Preserving directional continuity on curves can be tricky because the camera may shoot across the curve and a subject moving left to right would be filmed across the curve as moving right to left. This will not matter if the entire curving movement is shown and the viewer knows why opposite movement was depicted during the shot and the original direction is again filmed when the subject exits the frame. Therefore a moving subject may be filmed moving in opposite direction as it follows the curve, providing it enters and exits the frame correctly.Entrance and exit at the same side of the frame will not intercut with other shots moving in constant direction. A curve may be utilized however for a deliberate switch in screen direction. In this case the entrance would be correct but the subject would curve around and exit the same side of the frame. This will intercut with following shots going in the opposite direction and it will be accepted by the viewer as a natural change in screen direction.

When filming a subject turning a corner, the action axis should be drawn around the corner and the camera positioned on the same side for all shots. A corner also may be used to switch directional movement deliberately. The moving subject should then exit the frame as viewed from across the axis, so that the moving subject travels in the opposite direction to that established.

Established directional movement need not be maintained, when the subject goes through doorways. Whenever difficulty arises, it is fairly simple to bring the subject into the new setting in a head-on shot, and switch direction if desired. For precaution players exits should be filmed with the set-up for the establishing long shot and before lighting is changed for the following closer shots. When in doubt, it is easier to take an exit immediately after filming the entrance and to discard the shot if not needed than to set all up again.

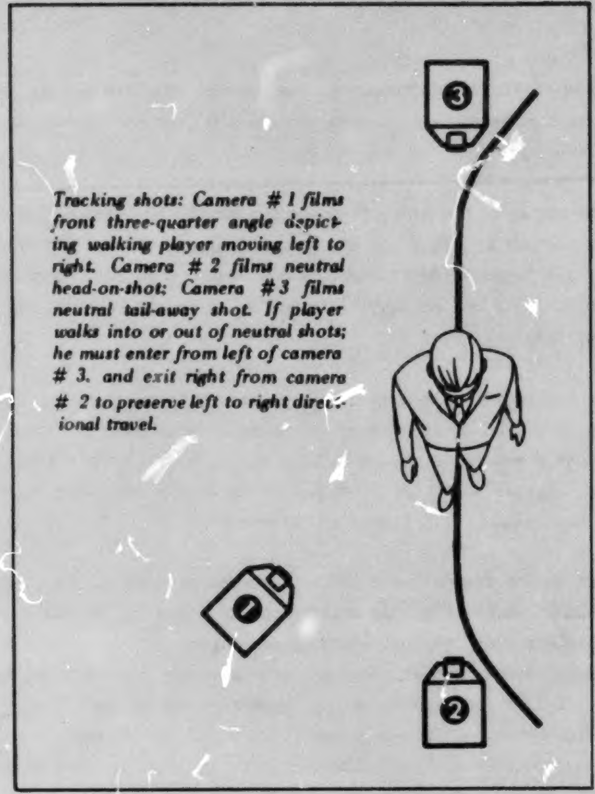
Sometime it is necessary to film a subject moving opposite to the established direction, be it because of light, background or other production factors. If in this case both, the camera viewpoint and the subject movement are transposed, i.e. the subject moves in the opposite direction and the camera takes the movement from the opposite side of the action axis, the relation between both remains the same and the original travel direction results. When cheating the action axis while shooting outdoors, care must be taken, that the angle of the sun and shadows do not disclose the cheat. Around noon or in close-ups with the use of reflector light not many problems should evolve but in long shots at other times of the day it may be necessary to shoot in the morning to match the established sun angle and shadow pattern of an afternoon shot.

It is impossible to depict progression if the moving object is already in the center of the frame when the scene starts and does not exit the frame during the shot. If the moving subject is always more or less center-screen and stays there when the shot ends, the subject seems to remain on the same spot but the background changes abruptly. This will result in a jumpcut, especially when the subject is filmed with the same image size and camera angle in consecutive shots. Therefore in a series of moving shots filmed against different backgrounds, the subject should enter and exit the frame to provide the editor with progression from one shot to the next.

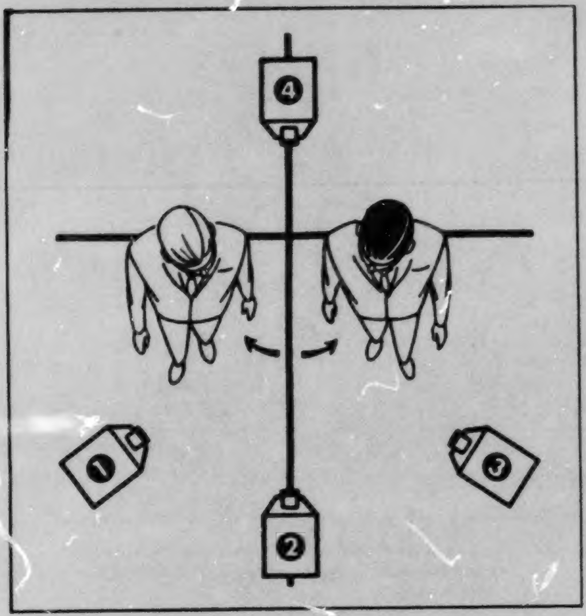
An exit made close to the side of the camera should be followed by a shot showing the subject entering the frame in a similar way, and not entering at the far side because the distance is too great to be covered between straight cuts. Exits and entrances through doors should be carefully matched when cut.

If there is no spatial progression in a series of shots, i.e. the background remains the same, the moving subject may remain center-screen. Thus a medium-shot or close-up may intercut with a long shot. In this case one could let the subject enter and exit the frame in the first and last shot of a series to provide progression with bracketing sequences.

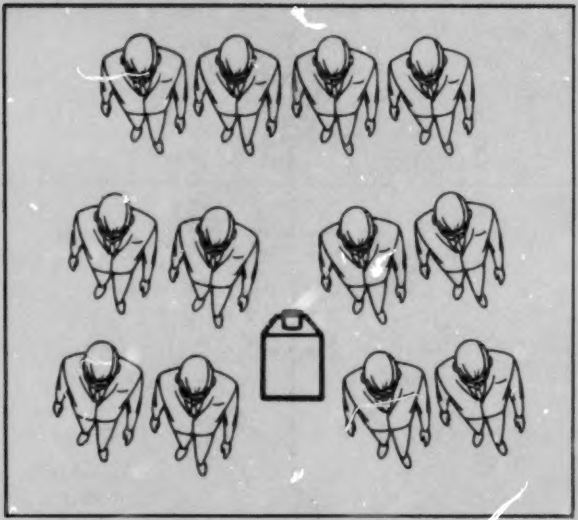
If a subject is not travelling but only movement as such is being shown, as in individual shots of moving action such as a man on horseback or a racing car, the subject may be filmed center-screen without an entrance or exit. The movement here will be indicated strongly through the changing background. If in a reaction close-up a player on screen should turn his head to follow moving action, he should act, as if the moving subject were placed behind the camera. These reaction shots may also be used to distract audience when screen movement is switched to the opposite direction. In this case, the player would follow the direction of movement of the second series of shots. Such reaction shots may be filmed after the picture is completed, if it is necessary to polish a sequence. Travel over great distances to existing places should be filmed with map direction. In the human mind east is established as being right, and west as being left. Since north and south on maps are at the top and bottom, it is wise to show northbound travel on a line ascending from lower left to upper right and southbound travel on a line descending from upper left to lower right. All screen travel must be thoroughly analysed before shooting. Notes and diagrams are especially useful if for example long shots are filmed on one day and the closer shots which need to intercut, on other days.



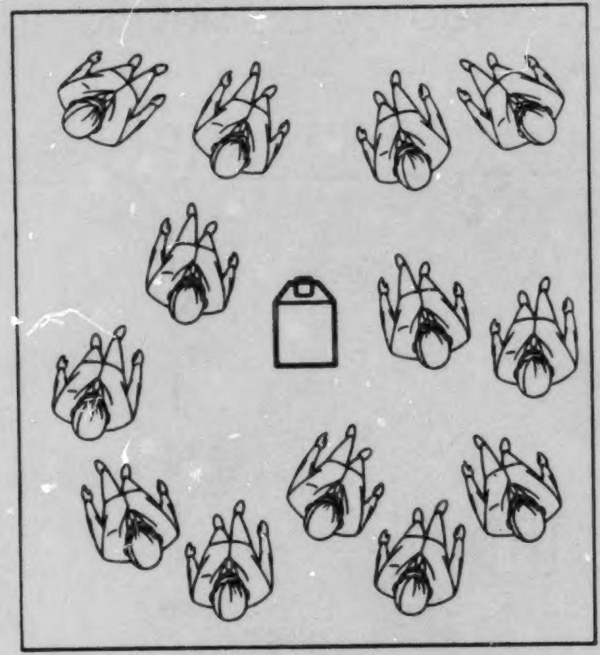
Tracking shots: Camera # 1 films front three-quarter angle depicting walking player moving left to right. Camera # 2 films neutral head-on-shot; Camera # 3 films neutral tail-away shot. If player walks into or out of neutral shots; he must enter from left of camera # 3. and exit right from camera # 2 to preserve left to right directional travel.



Exception to crossing action axis occurs when two players look at each other as they walk or ride. Two-shot static action axis should be drawn through moving players. Camera may be positioned on either side of travel axis to shoot opposing shots of moving players – in the same manner that they would be filmed standing still.



Directional travel is neutral when two or more players walk abreast toward camera, and then split up to exit both sides of frame.



Directional travel is neutral when several players enter frame from both sides of camera and join up going directly away.

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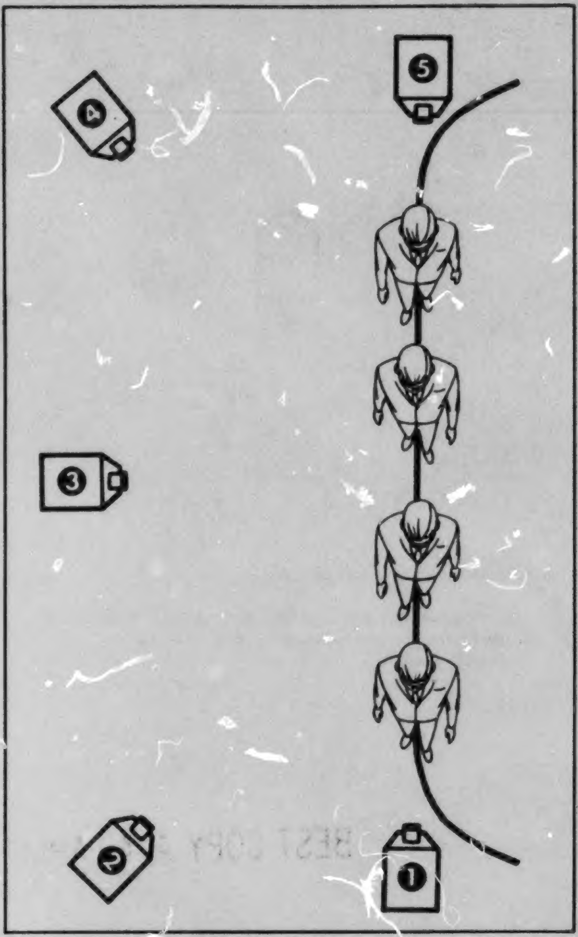
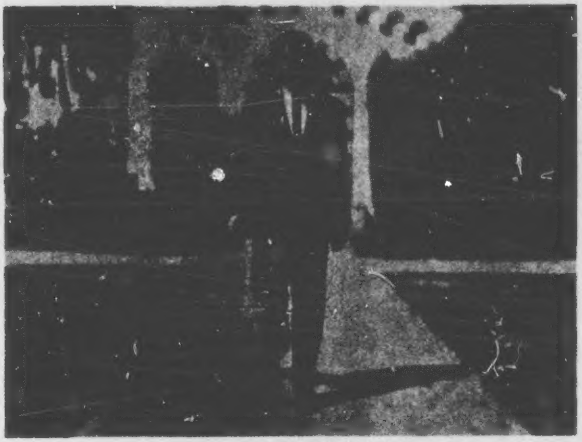
SCREEN DIRECTION ON MOVING SUBJECT





Camera # 1 films head-on shot of walking player. Player exits screen right to establish left-to-right directional travel.

Camera # 2 shows player in front three-quarter angle as he enters from screen left, crosses and exits screen right. This angle is excellent for tracking a moving player or vehicle.

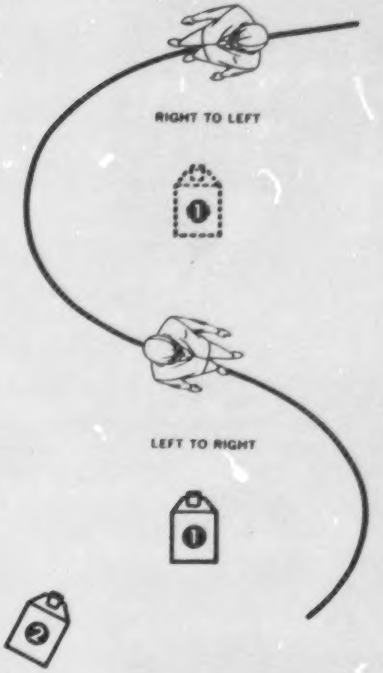
Camera # 3 records player moving left to right across screen. Shot may be static, or camera may be static for entrance, pan player for short distance, and hold static for exit – screen right.

Camera # 4 films rear three-quarter angle of player, who enters left, exits right.

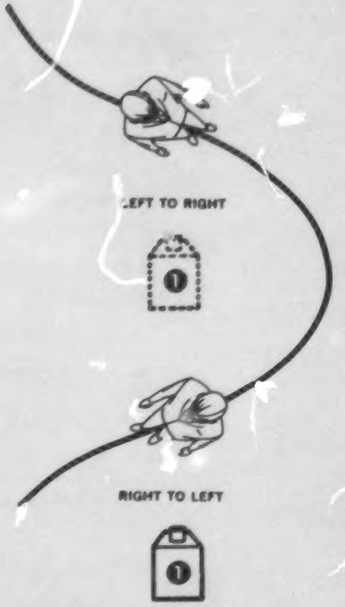
Camera # 5 depicts player entering frame screen left and walking away from lens in tail-away shot, as he enters building. Player may be filmed with any or all of these camera set-ups; with assurance he will travel left-to-right – regardless of whether static or moving shot; long shot, medium shot or close up; or whether player is moving toward or away from camera.

Camera should remain on same side of travel axis to show player leaving building for return to starting point. Player moves in contrasting right-to-left screen direction. Head-on or tail-away shots may be filmed in same manner.

ACTION AXIS ON CURVES

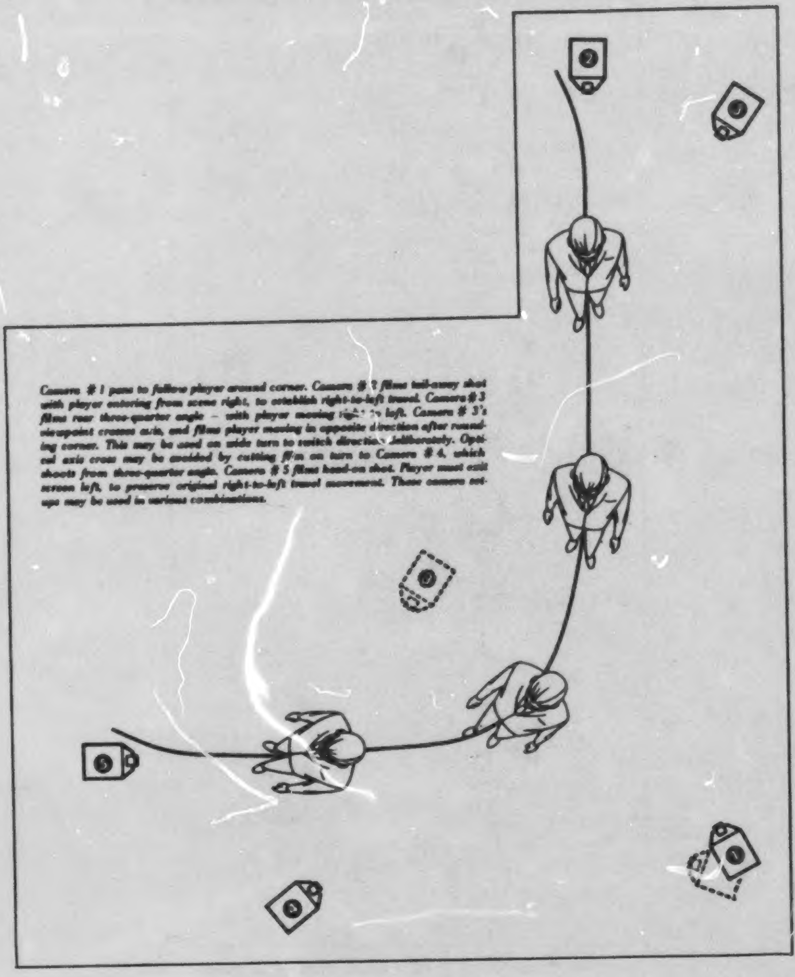


Camera # 1 is positioned on proper side of travel axis – to film subject moving left to right. Camera # 1's viewpoint crosses axis optically, and films subject from wrong side moving in opposite direction. Camera # 2 films entire curving movement, so that subject is shown turning and moving correctly when crossing camera and exits.



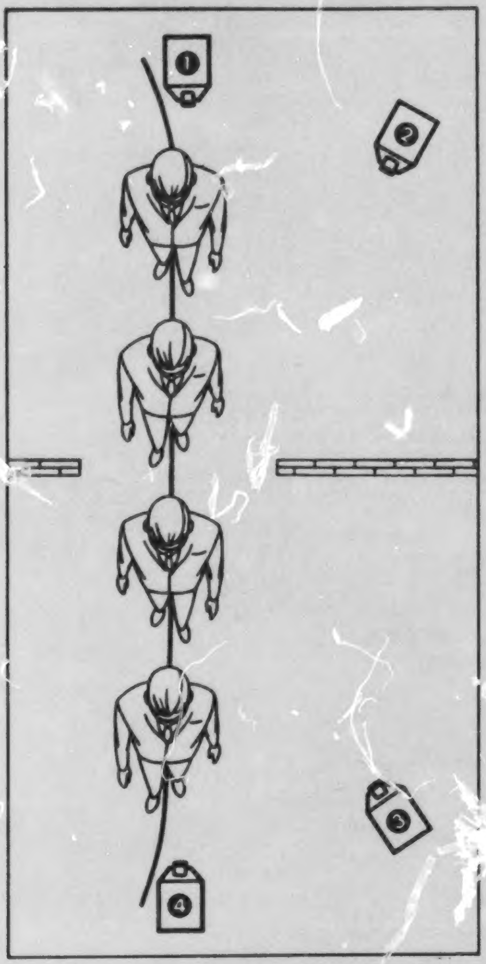
Curve may be used to switch travel direction deliberately. Camera # 1 is set up on wrong side of travel axis – so that its viewpoint crosses axis optically, and films moving subject with correct left-to-right movement at beginning of shot. Subject then curves in front of camera # 1, and travels in opposite direction – right to left. Subject exits left, and will match cut with subject travelling right to left.

ACTION AXIS ON CORNERS



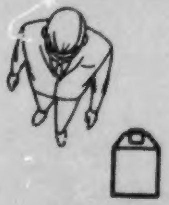
Camera # 1 pans to follow player around corner. Camera # 2 films tail-away shot with player entering from scene right, to establish right-to-left travel. Camera # 3 films rear three-quarter angle — with player moving right to left. Camera # 3's viewpoint crosses axis, and films player moving in opposite direction after rounding corner. This may be used on wide turn to switch direction deliberately. Optical axis cross may be avoided by cutting film on turn to Camera # 4, which shoots from three-quarter angle. Camera # 5 films head-on shot. Player must exit screen left, to preserve original right-to-left travel movement. These camera set-ups may be used in various combinations.

ACTION AXIS ON DOORWAYS

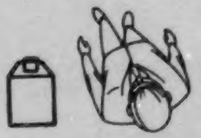


Since doorways create a new deal, directional continuity may or may not be maintained. Neutral tail away (Camera # 1) and head-on (Camera # 4) shots may be used – with proper entrance and exit to maintain screen direction – or wrong exit (Camera # 4), to create a new directional movement. Three-quarter side angles may be used (Cameras # 2 and # 3) – if player is filmed cross-screen, and directional continuity is maintained.

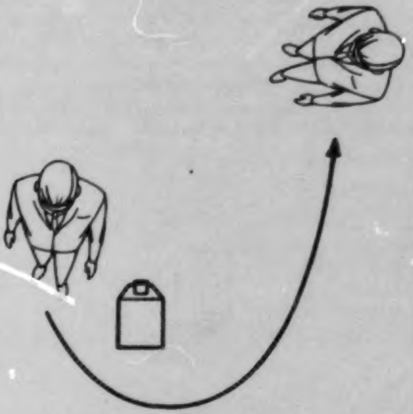
ENTRANCES & EXITS



Exit made close to side of camera –

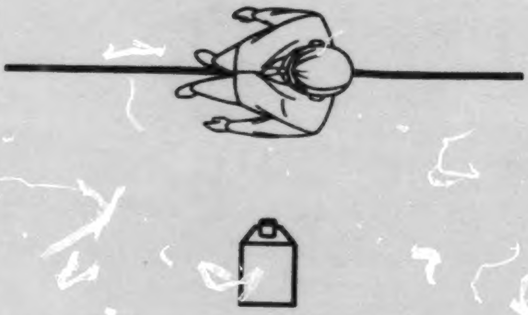


should depict subject entering frame in same manner. Exit to screen left would be followed by entrance from screen right.

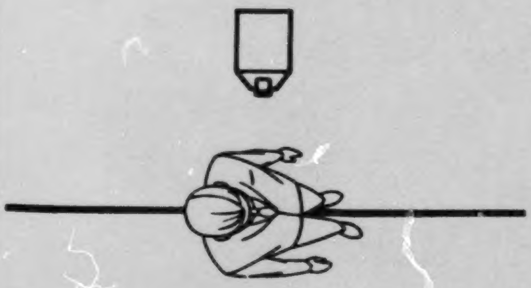


Moving player should not exit close to side of camera, and enter next scene at far side – and walk cross-screen. Off screen distance is too far to travel between consecutive shots.

CHEATING ACTION AXIS



Action axis may be cheated – to take advantage of sun angle, background or terrain – providing both subject movement and camera position are reversed. Subject may move in opposite direction, if camera is moved to opposite side of axis. Thus, subject movement and camera set-up relationship remains the same.



The following sequence from Martin Rackin's production of STAGECOACH illustrates how Dynamic Directional Continuity is established and *maintained.*

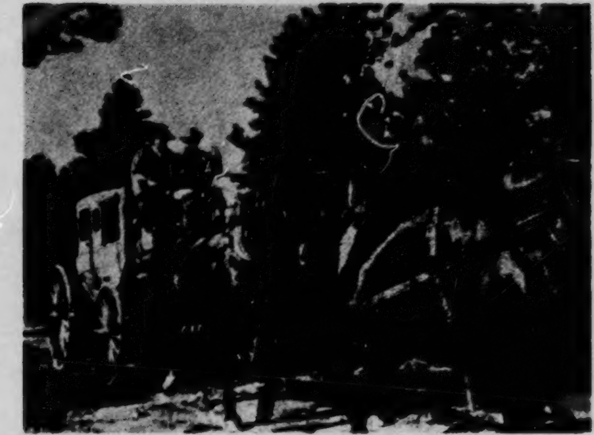
Stage coach is established moving left to right in a front three-quarter angle.

Stagecoach continues travelling left to right in cross screen shot.

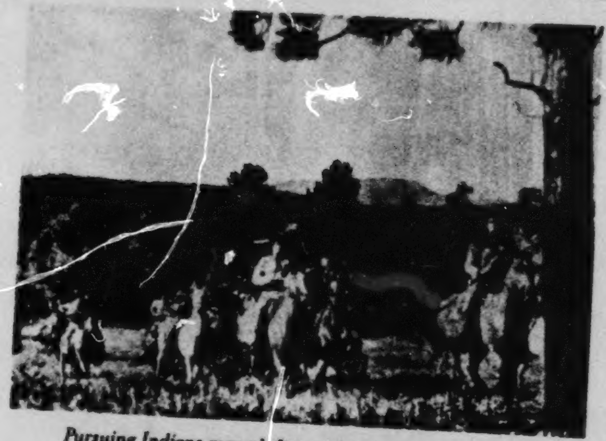
Players are filmed from exterior camera angle, from same side of travel axis.

Interior shot shows players from similar angle

Reverse shot of opposite players is filmed from same side of action axis.

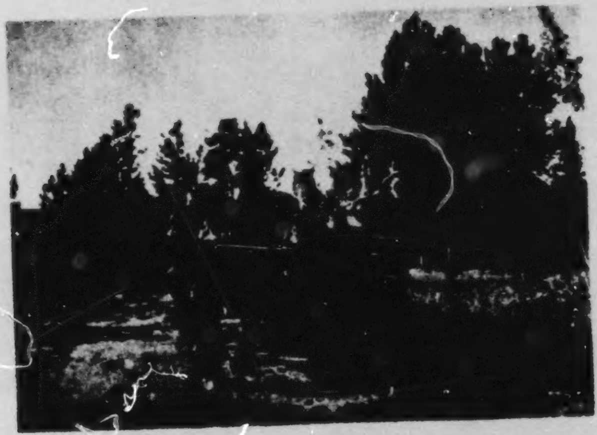


Coach continues on its way. Vehicle enters screen left, and exits screen right.

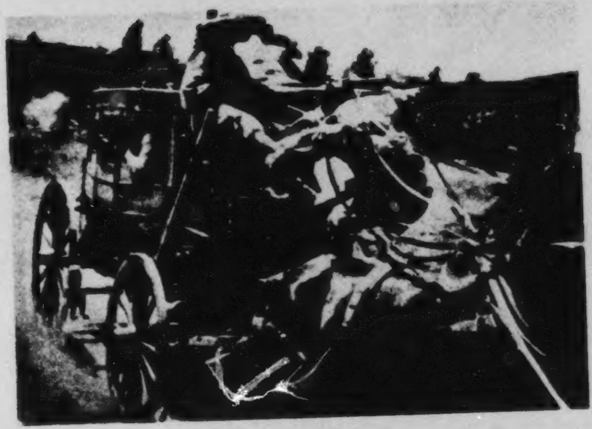


Pursuing Indians move left to right.

Driver is filmed in three - quarter angle medium shot from same side of axis.



Stagecoach must exit screen right to preserve established travel direction.



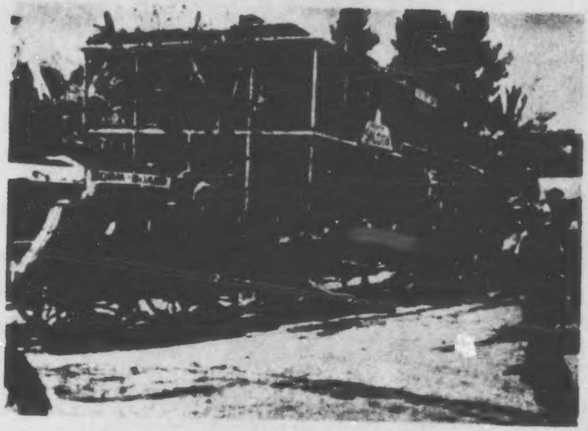
Coach filmed in three-quarter angle .

Three-quarter angle shot shows attackers.

Cut-away shot reveals U. S. Cavalry coming on scene.

Shot of troopers maintains direction.

Indians are driven off, and cavalry escorts stagecoach to destination.



Stagecoach enters town – still travelling left to right.

Coach pulls up to depot – left to right.

It is also necessary to study the terrain for sun angles, camera set-ups and backgrounds at the time of the day that the various shots will be filmed. Sometimes a particular location or building must be filmed from a certain angle which will then decide the screen direction for the rest of the sequence. Travel sequences which include interior scenes, must be carefully planned with both interior and exterior camera set-up in mind.

STATIC SCREEN DIRECTION

Static screen direction is concerned with the way in which players' face and look on the screen. Even when bodies are at rest the way people relate to each other indicates direction. Moreover the direction in which a player moves in one shot must match the direction in which he looks in the next shot and vice versa. So even in static scenes established directional continuity must be maintained.

The position in which a player faces may not necessarily be the direction in which he looks. Therefore, matching the look is the important thing in static screen direction, rather than simply matching facing positions. A player may not look left in one shot and then suddenly look right in the next shot. In intercutting close-ups of people talking to each other, their looks must go in the direction where the partner is supposedly located. This also applies to scenes between animate and inanimate subjects if a man is shown looking up at a sign the sign must be shot from a low angle in the following shot. Also in matching the look or "eyeline" the principle of action axis is a means of remaining on one side of the players, so that their positions and looks appear consistent from shot to shot regardless of players or camera movement.

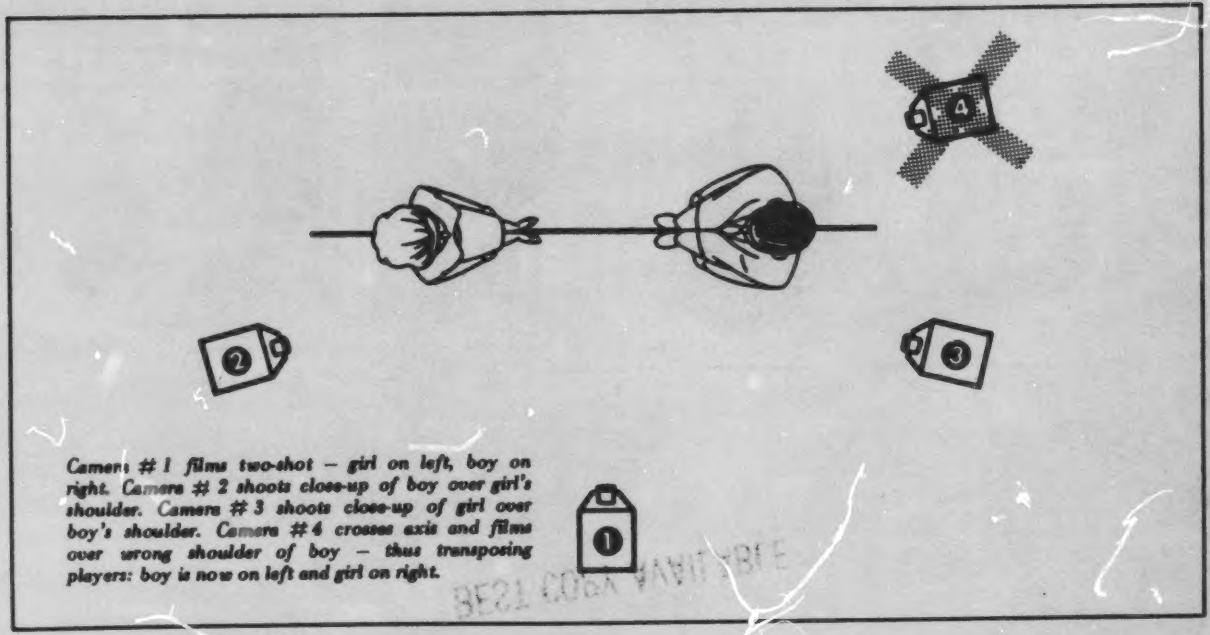
The action axis is established by drawing an imaginary line through the bodies of the two players nearest to the camera on opposite sides of the picture.

The camera viewpoint and the players look must remain on the same side of this imaginary line in consecutive matching shots. A sequence of shots may be filmed by placing the camera anywhere within the 180° arc which may be described on one side of the players. If the camera crosses the line and views the players from the opposite side they will be transposed on screen so that a player seen on the right in one shot, will suddenly appear to be on the left in the next shot. A look that will be recorded as being in the opposite direction than that previously established. The camera may cross the action axis either optically, with a telephoto or zoom lens, or in reality to film a player at the rear of the set, providing the camera angle is in keeping with the established action axis. This would be the same as if a new action axis is drawn which goes parallel to the original axis.

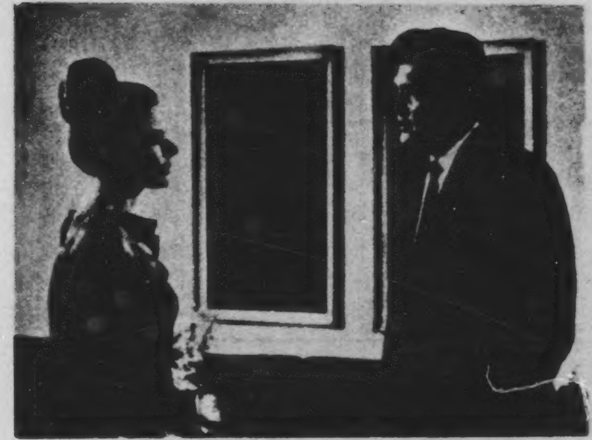
A centered person facing the camera may look right or left, up or down, or straight into the lens, without turning his head. Any change in look must be shown. But it must not occur between shots, so that suddenly a player looks into the other direction than that shown in the previous shot. In a series of consecutive shots, for example in individual opposing close-ups of two players who face the camera but relate to each other, matching the look is extremely important. The two points to consider here are the height of the gaze and to which side of the camera the glance is directed. In high and low camera angles, for instance, when a grown-up relates to a child or standing player to a sitting one, the look should be directed slightly above the lens by the player looking up and slightly below the lens by the one looking down. But in both cases the look must be directed to the side of the camera. Since it can easily happen that the look crosses the action axis, i.e. is directed to the wrong side, it is usually better to position the off-screen player on the proper side of the camera. Otherwise, if the onscreen player has to read his lines to an imaginary partner it may easily happen, that he looks into the wrong direction. Players' movement into or out of close-ups must also be handled very carefully.

This is particularly important when the camera is close to the line. As for example in a point-of-view close-up. It is very easy to make a mistake and look in one direction and then exit in the opposite direction. So in all cases where entrances or exits are close to the side of the camera, movement should always occur between the lens and the action axis. Sometimes a player has to relate to persons on either side of him or he has

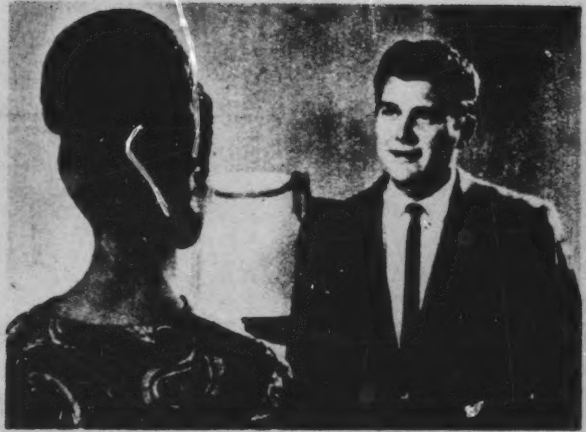
STATIC SCREEN DIRECTION



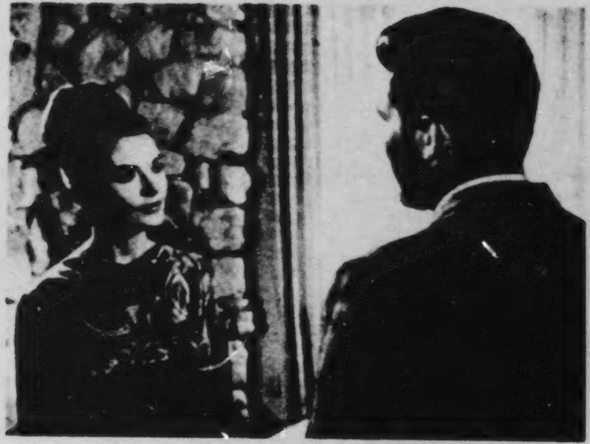
Camera # 1 films two-shot – girl on left, boy on right. Camera # 2 shoots close-up of boy over girl's shoulder. Camera # 3 shoots close-up of girl over boy's shoulder. Camera # 4 crosses axis and films over wrong shoulder of boy – thus transposing players: boy is now on left and girl on right.



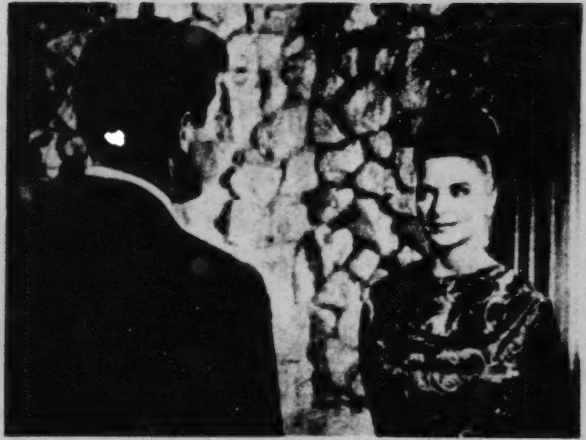
Camera #1: Two-shot – girl on left, boy on right.



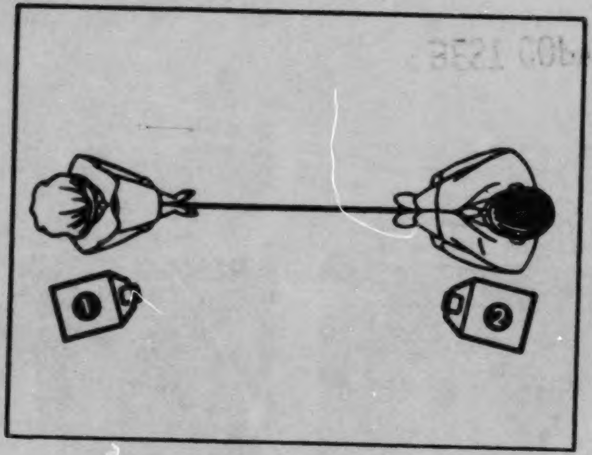
Camera #2: Over-shoulder close-up of boy.



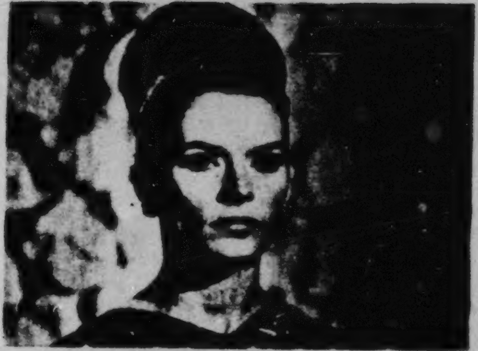
Camera #3: Over-shoulder close-up of girl.



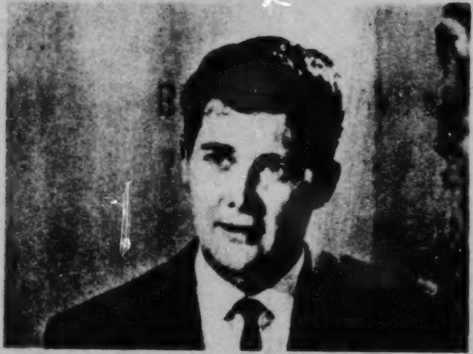
Camera #4: Over-wrong-shoulder close-up of girl. Players are transposed.



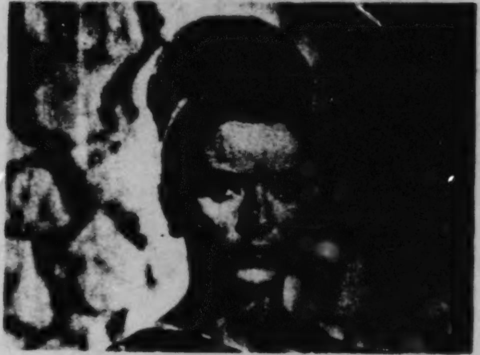
Camera set-ups for opposing p.o.v. close-ups should be very close to the side of players, so that look is to side of lens.



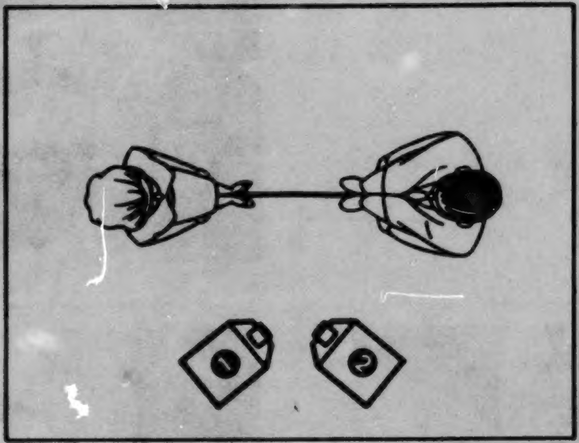
Camera #2 films girl from boy's point-of-view.



Camera #1 films boy from girl's point-of-view.



Girl's look has crossed axis, and created new look in opposite direction.



Camera set-ups for opposing three-quarter angle close-ups are made from impersonal objective angles.

Camera #2 films girl.

Camera #1 films boy.

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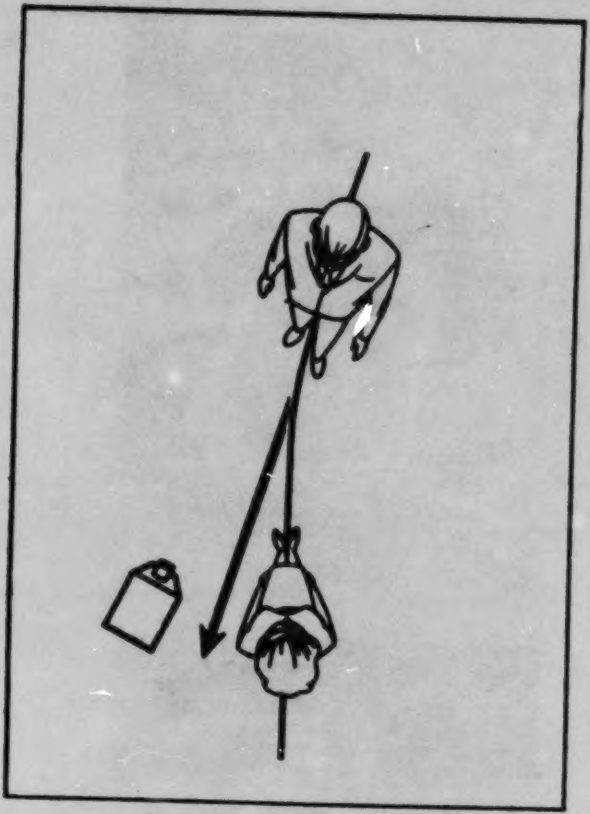
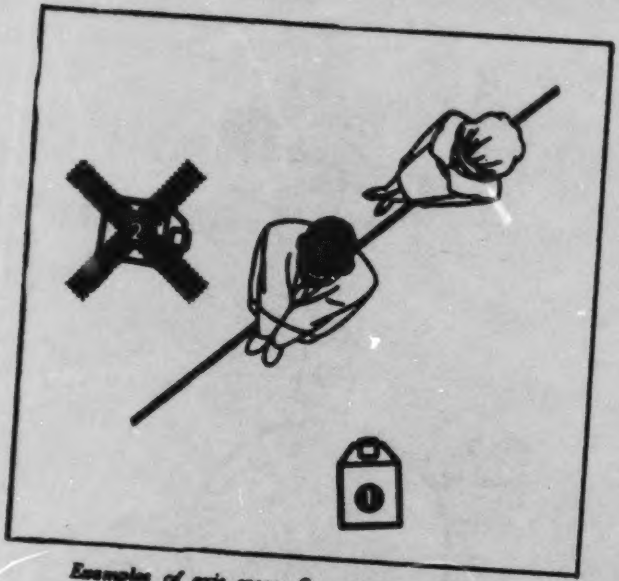
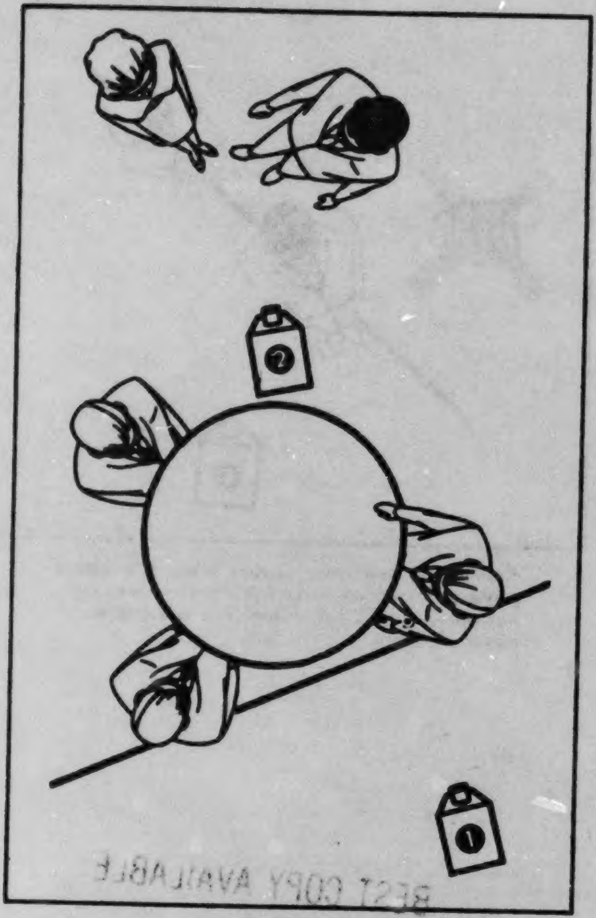


Player in close-up relating with off screen player must exit scene between camera and action axis. This is particularly important in p.o.v. close-ups because player is working close to the axis and filmed almost full face to the camera.



Examples of axis cross: Camera set-up # 1 depicts player with knife on screen left — girl on screen right. Camera set-up # 2 has crossed axis, and transposed players on screen.



Camera viewpoint may cross action axis to film players in rear of set. Camera #1 films full shot. Camera #2 may be positioned across axis to film medium shot of rear players. This is the same as drawing parallel axis or shooting across original axis with longer focal length lens.

to look from an on-screen player to an off-screen one. In these cases the player's look has to pass the camera. The trick here is to let the gaze sweep just above or below the camera, depending on the camera angle and to avoid looking directly into the lens.

Each look into a new direction creates a new action axis. This also happens when players move during a scene. The action axis moves with them! Therefore matching the look in shots which contain movement, requires even more care and planning than in static scenes. When consecutive shots are filmed in chronological order, it is fairly simple to match the look of moving players. If taken earlier, it is useful to draw the action axis at the particular point, in the master scene where the close shots will be cut in. With the aid of chalk or tape marks on the floor, to duplicate the axis and the player's position, returning to any position can be made fairly easy.

An individual, sitting at a desk or working at a machine should be filmed with a consistent look in a series of consecutive shots.Also here the principle of action axis holds true, because the look of an individual must also be consistent on each side of a cut. A worker operating a machine should not be shown first from his left side and then from his right. Normally in such a situation a person relates to his work, i.e. the direction he is facing. Therefore the action axis is drawn in this direction through him. So if, for instance, the person is sitting at a desk, signing papers, he may be filmed in a front three-quarter angle facing screen left.

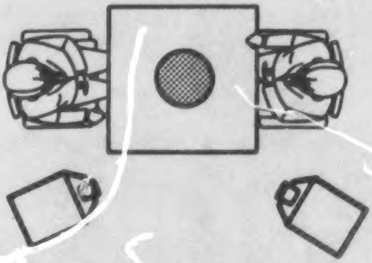
An over the shoulder shot showing him, signing papers, would be filmed over his left shoulder. If the camera would shoot over his right shoulder, it would cross the line and present the player transposed. If the player is left handed, it would be better to show him always from the right, since a left over the shoulder view would obscure the action he is performing. Also if multiple cameras are employed to film the person, all of them should be positioned on the same side of the axis, so that he appears not suddenly transposed in a shot.

Handling the action axis when filming a *speaker* talking to an audience, differs from shooting a play or event performed for an audience. The actors in a play relate with each other across a stage in a play. A speaker relates directly with the audience when addressing them. Therefore the speaker and each member of the audience should have opposing looks in the respecting shots, the same as in two-shots. There are two ways to film a speaker and an audience, which both may be employed individually or in combination.

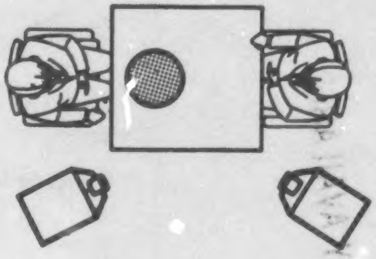
The action axis may be drawn down a center line, i.e. the center aisle. The camera may be positioned on one side, shooting towards the centerline. So profile close-ups, three-quarter angles and point-of-view close-ups of both sides may be filmed where the speaker will always look in one direction and the members of his audience in the opposite direction. Long and medium shots of the auditorium may be filmed from the rear towards the stage, or from the stage towards the audience, with the camera close to the axis, or from the corners of the room for angle shots. In both cases the opposing looks will be preserved.

The alternate method is to draw the action axis across the audience, parallel to any row of seats. The row of seats then would be the base, the speaker the apex of a triangle. The camera may be positioned anywhere within the triangle. This is similar to the three-shot.

This arrangement results in greater visual variety because it allows to shoot both sides looking in either direction. Nevertheless it is wise editorially to choose matching consecutive shots which depict opposing looks, so that a look by the speaker is followed by a look by a member of the audience in the opposite direction in the inter-cuts. Medium shots of several people or individual close-ups should look in accordance with their locations. Long shots towards the stage or towards the audience filmed from opposite sides of the centerline should be avoided directly one after the other, because speaker and audience will face the same direction not towards each other. In general these scenes are not as easily misinterpreted as far as the matching look is concerned, because the audience is in a fixed situation with a definite front and back.



Opposing close-ups of players should not be filmed with microphone, crystal ball, bowl of fruit, or other object, on table between them, which will appear on right in one close-up, and on the left in other (above). Object should be excluded or positioned closer (below) to one player, so that it appears in his close-up only.



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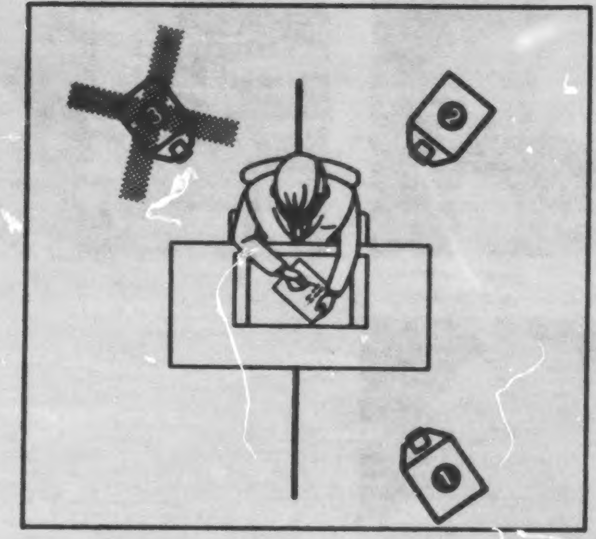
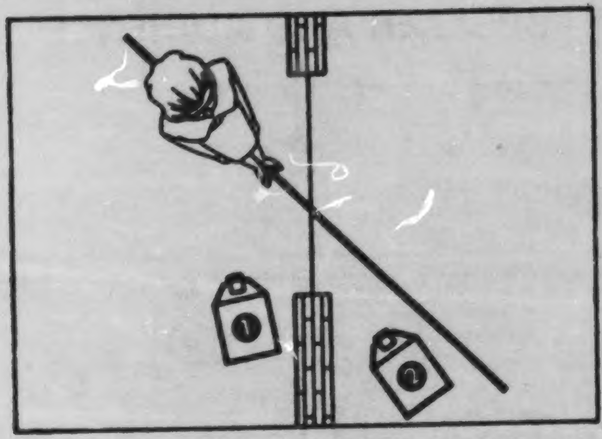


Camera # 2 films over left shoulder. Man is still facing screen left.

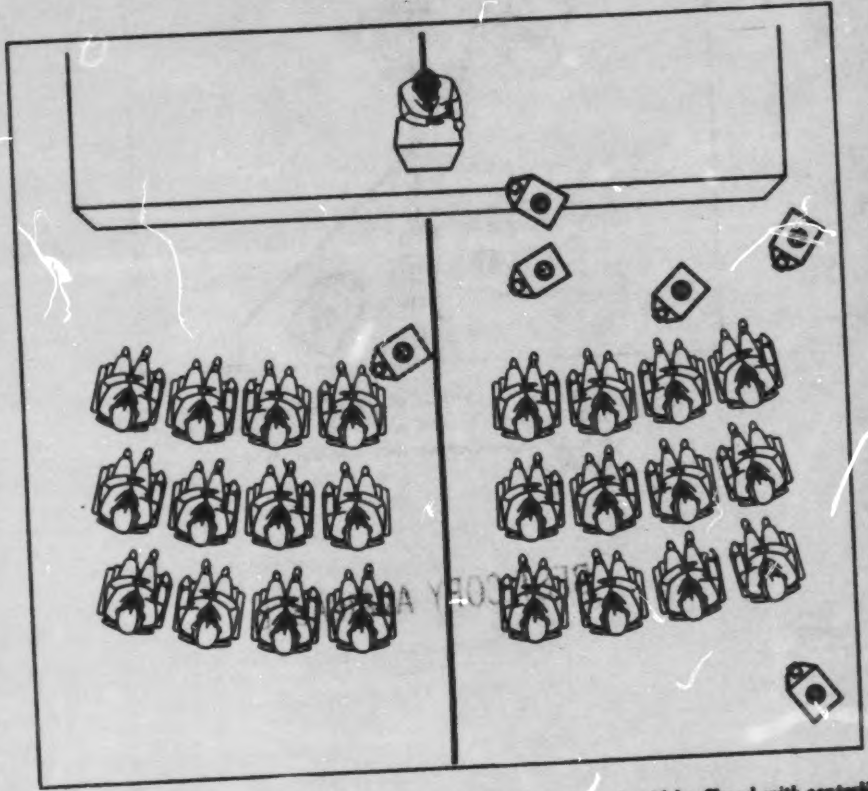
Camera # 1 films three-quarter angle of man facing screen left.

Camera # 3 is positioned across axis — films over right shoulder. Man is transposed — now faces screen right.

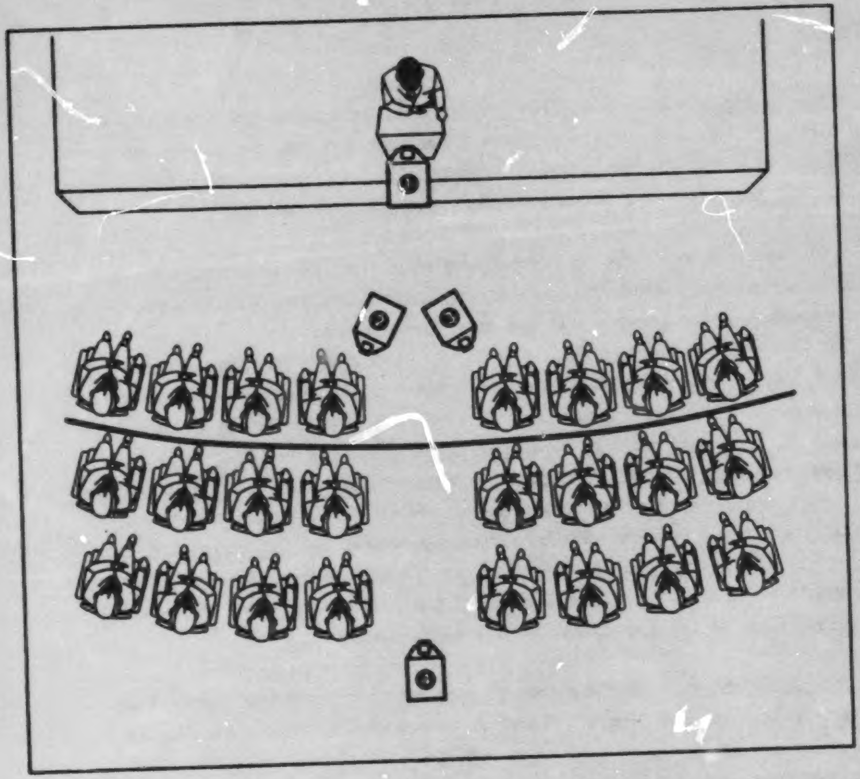


Person looking through window should have action axis drawn in direction of look. Both interior and exterior camera set-ups should film from same side of axis.

SPEAKER AND AUDIENCE



Since stage speaker relates directly with audience, theater sequence should be filmed with centerline axis for opposing speaker-audience treatment — similar to filming two players in opposing close-ups. Camera #1 shoots toward stage for long shot of audience and speaker on stage. Camera #2 films opposing long shot of audience from same side of theater. Camera #3 films speaker facing screen left. Camera #4 films audience facing screen right. Camera #4's viewpoint may cross axis optionally — to film close-ups of individuals. Camera #5 films individuals on opposite side of theater with screen right look. All camera set-ups shoot toward centerline, to present speaker with look toward screen left; and members of audience with opposing look toward screen right.



Theater sequence may be filmed with parallel axis (line running parallel with rows) Camera #1 films speaker, who may sweep his look left and right – to relate with members of audience on both sides of theater. Camera #2 shoots members of audience on left side of theater, with look toward screen right. Camera #3 shoots those on right side, with look toward screen left. Shots of audience and speaker should be inter-cut with opposing looks for best pictorial effect. Camera #4 films neutral shots from rear of theater. Centerline axis and parallel axis may be combined in lengthy sequence – for visual variety.

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Three-shots require special consideration in accordance with their staging. There are two types of three-shots: Those with one dominant player who relates with two others, situated close together, and those with three players' spread apart who take in turn the dominance over the scene.

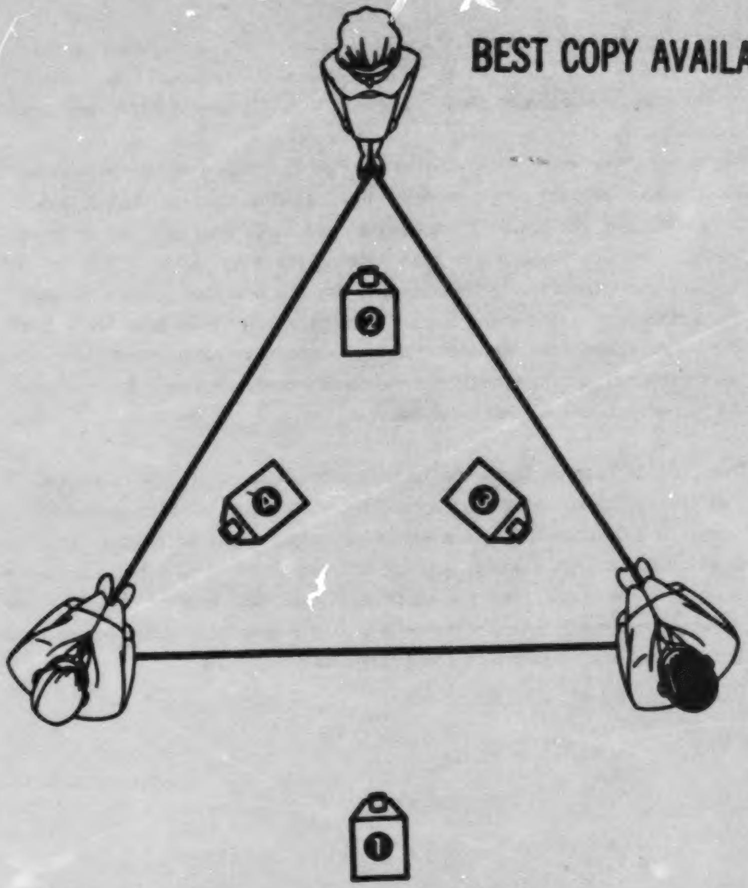
For the first type, the dominant player should be located on one side of the screen and the two others on the opposite side. The two supporting players are treated as a unit and over-the-shoulder. objective or point-of-view close-ups may be filmed as in two shots. Here the camera is positioned on the same side of the action axis drawn through the two players nearest to the camera on opposing sides of the screen. The supporting players may be filmed together or in individual close-ups and both show the same direction of look. Each time the dominant player looks only at the one supporting player further away from the camera, a new action axis has to be drawn. The camera may now be positioned between the two supporting players to film a front-face close-up of the dominant player. The second type should be filmed with a single axis. If the players are spread out, two players are in the foreground and one in the background.

The two of the three which relate to each other at a time are treated as a pair in a two-shot series. Therefore the camera may only optically cross the action axis at that time to include the rear player. When the rear actor comes into action and communicates with one of the two others, a new series of two shots starts. So the three-shot becomes a series of two shots, with each two-shot creating its own axis as players change the direction of their look. Difficulties may be involved when filming a group of players seated at a table, particularly if the table is round. These scenes should be well established, so that the viewer is not confused when two or more players shown in two-shots or in individual close-ups speak to off-screen players. The axis should be drawn through the two players nearest the camera on opposite sides of the screen. The camera may cross the action axis either optically or by drawing a new axis parallel to the original one to film far players. It is also best in this case to break up the scene into sets of two-shots, which show players relating to each other with opposing looks. But it is necessary to pull back from time to time to re-establish the scene.

Reverse shots pose little difficulties in settings, where the players are positioned in fixed seats, such as churches, theatres, courtrooms or vehicles. Furthermore these locations have distinctly different fronts and backs, so that the viewer knows, that not the players but the camera has moved. Even then it is wise to stay on the same side of the axis and shoot either neutral front or rear views. Also a location with distinct features, like staircase or bookshelves, or large doorways is rarely confusing. However, in locations that have no striking features such as walls, curtains, and the like, a reverse shot may be confusing because it depicts the actors from a new angle but in front of a similar background. Or, if the location has distinct features but is not well established, reversing the camera may show a totally unknown background and seemingly transpose the players to a different setting.

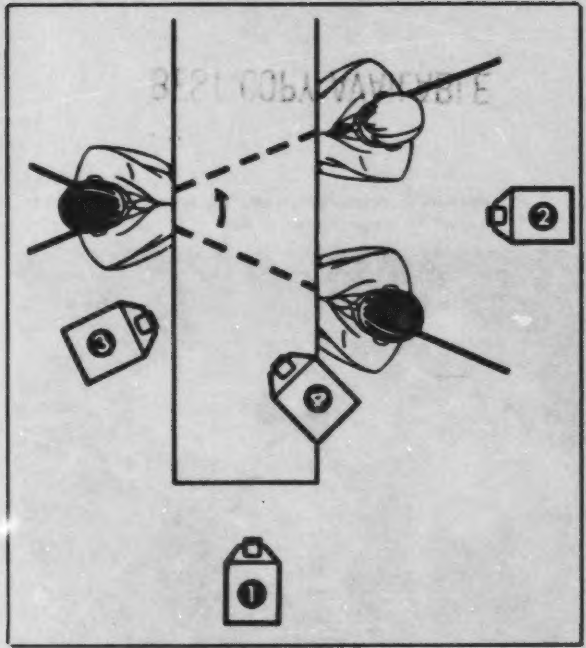
Therefore in reverse shots the location should be so well established, that the viewer knows it geographically. Also in shots which contain motion, travel in a constant direction will help orientation. If a group of players in a fixed position suddenly looking off-screen in a new direction, a reverse shot may reveal that they looked in that direction to observe a new player entering the room. With the new player entering, a new action axis is drawn and the sequence can continue along this line.

THREE SHOTS



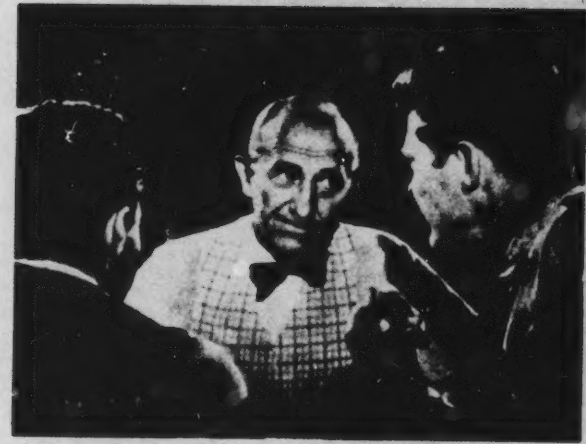
ACTION AXIS FOR THREE-SHOT

Action axis for three-shot. Camera # 1 shoots across parallel axis (similar to theater, with M.C. facing camera and members of audience on either side of center). Camera # 2 may make optical cross to film close-up of girl – who may look in either direction to relate with boy on left in opposing close-up (filmed by Camera # 4), or with boy on right (Camera # 3). Three-shot may be broken up into two-shots and opposing close-ups.

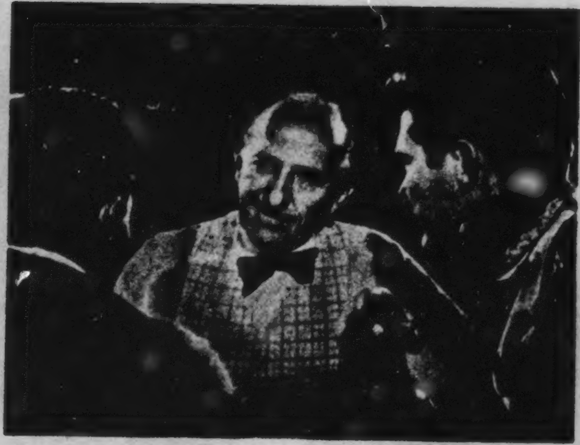


Three-shot in which one person dominates, may be filmed from side angle; with dominant player facing right, and supporting players facing left. Camera #1 films entire group. Cameras #3 and #4 may film opposing close-ups. When bartender looks or serves drink — to player in right background, new action axis is created. Camera #2 films bartender looking right to preserve original look.

Camera #1 films side angle — bartender turns toward player in right background.



Cut to Camera #2 may be made when bartender turns towards player in right background – creating new axis.



Bartender may later turn to player on left as scene progresses.

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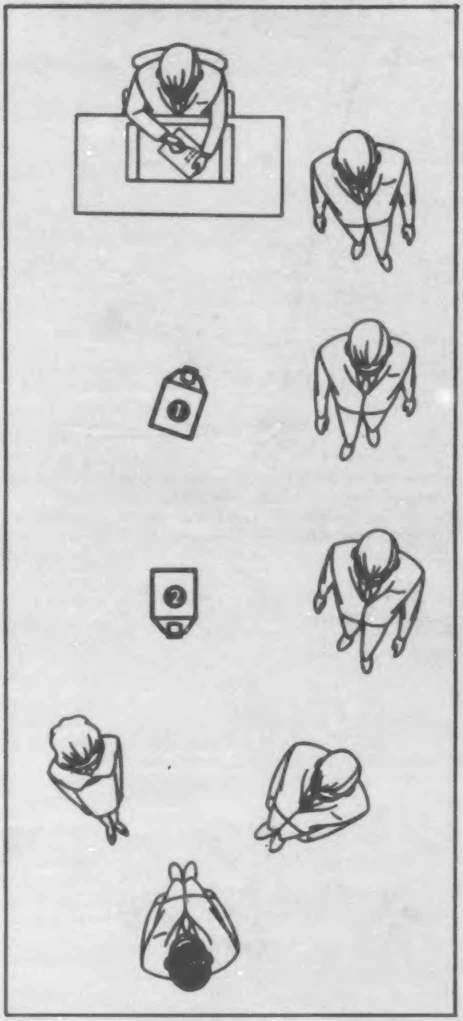
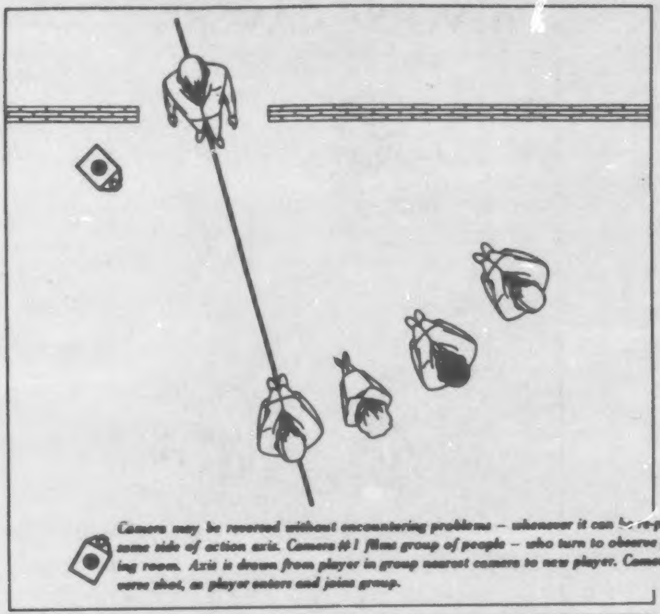
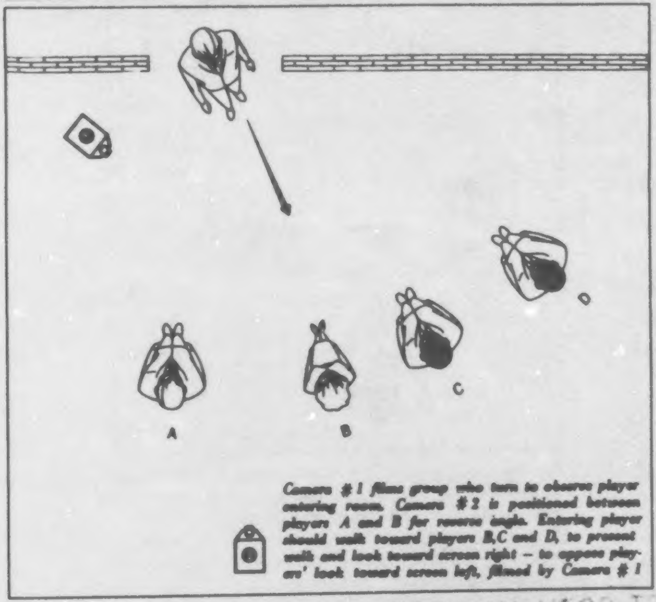
REVERSE CAMERA



Reverse camera set-up for person crossing room should be based on mental pan. Camera #1 films player, who rises from desk and exists screen right. Camera #2 films reverse angle – as if panned around – as player enters screen left, joins other players on opposite side of room.



Camera may be reversed without encountering problems — whenever it can be re-positioned on same side of action axis. Camera #1 films group of people — who turn to observe player entering room. Axis is drawn from player in group nearest camera to new player. Camera #2 films reverse shot, as player enters and joins group.



Camera #1 films group who turn to observe player entering room. Camera #2 is positioned between players A and B for reverse angle. Entering player should walk toward players B,C and D, to present walk and look toward screen right — to oppose players' look toward screen left, filmed by Camera #1

THE LABORATORY

The professional motion picture labs we are concerned with do most of their work in 16 mm. If you have any problems or questions associated with the film, get the information before the film leaves your hands. Include any special instructions in a note with the film. You may want the film pushed, so your note might read: force develop film one stop; if it's a 200 speed film you might say, develop at 400.

When asking lab personnel about the quality of pushed film, remember they are used to dealing with commercial filmmakers whose concept of what constitutes acceptable quality may be quite different from yours. Great big balls of grain, or weird colour shifts may be desirable effects from your point of view. Quality can only be related to purpose; it is not an absolute. You would do well to ignore the lab's advice whenever you think you know better, or they seem incapable of understanding what you want. Of course, if they say they can not push a kind of film four stops, don't shoot it that way, or find a lab that can do that sort of processing.

Most labs charge a surcharge of from 50 to 100 per cent for forced development and they may have a minimum footage rate for billing as well. So check your lab's price schedule for details. If you present them with one hundred feet of film to be forced, you may wind up paying for four hundred feet. Some labs, if they process a lot of forced film, have no surcharge for this service.

The overall colour balance of film does vary from roll to roll, even within the same emulsion number. This is usually attributed to the processing. In fact, two rolls processed ten minutes apart can often have noticeable shifts in colour balance. For most purposes, minor shifts in colour are of little or no importance. They can be corrected in printing, if they seem troublesome; but often you are merely asking for trouble when depending on the ordinary lab's skill at colour correction.

If there are unusual marks on your film, they come from three sources: film manufacturing, the camera in which it was exposed or the processing operation. Manufacturing, errors are very rare.

Since the lab processing machines work continuously, as do the machines that manufacture the film, any mark of an intermittent nature can be attributed to something done at the time of exposure (or if you've projected the film, in the projector). However, you should not rule out the possibility that such defects were causedin processing (or manufacture). A defect which appears on each frame in the same position most likely has been made in the camera. Streaks can also be made in the camera. Dirt, usually from the emulsion, accumulates in the camera and gets stuck on the aperture plate. The film running by the dirt, pressed against it by the pressure plate, is made developable by contact with the raised material. One property that photographic emulsion has and you may know this from darkroom work, is that the application of pressure can make it developable, as if struck by light. Depending upon the dirt's position relative to the gate, the mark may have either an intermittent or continuous nature. The dirt, if located a frame or so away from the aperture, will produce intermittent marks and continuous marks further away from the aperture. Also, if the camera has a metal burr in the gate region, it can gouge out the emulsion, making a nasty tram line running the length of the film.

One curious defect is caused by static electricity. Static electricity marks which look like branched lightning in the night sky usually occur with high speed film at a high fps rate. Two important variables are the cameraman and the weather. Some people generate more static electricity than others and when the weather is cold and dry, static electricity is more likely to be a problem.

The lab is not responsible for static electricity marks, they occur at the time of exposure. The manufacturers have done a fair job of treating film so that such marks can be kept to a minimum. At one time, cameramen, grounded their cameras to eliminate static marks.

The lab can make a variety of mistakes as well. A blotched or mottled look, where the film loses density in the blotches, can be caused by improper washing and drying. It may seem strange that a water mark can cause the film to appear less dense, but the areas where marks appear have dried at a different rate from the rest of the film. During drying, a contraction of the emulsion in that region forms a craterlike depression. If the lab washes the film again, and dries it properly, the defect may be diminished.

All-over mottling of the processed film is often the result of uneven development, and nothing can cure this. Outdated film which is processed may have the same mottled appearance, and the lab should not be taken to task for this. Similarly, outdated colour film may have shifts in colour and reduction in contrast.

Variable Contrast

The contrast of processed film depends upon how long it was developed (first development for reversal emulsions). The longer it remains in the developer, all things (temperature and agitation) being equal, the higher the gamma or contrast. The less time it remains in the developer, the lower the contrast. Still photographers have taken advantage of this to control the contrast of their negatives. This was a simple matter when most workers used sheet film. For a contrasty subject, like a snow scene showing people wearing dark clothes, it was possible to underdevelop the film to reduce the contrast. With flat lighting that, for example, you might find under flourescent illumination or on an overcast day, the photographer could overdevelop the film to increase the contrast.

Varying the time of development also varies the film's speed or sensitivity. For example, let's say we have a film that is usually rated at 100 ASA. For contrasty subjects, we'd rate the film at 50 ASA, and underdevelop. For flat lighting, we'd call the film 200 ASA, and overdevelop to increase the film's contrast.

Many people recoil at this advice, because it leads to giving greater exposures under some very bright lighting conditions, the snow scene for example. It seems to defy common sense to give a greater exposure when there's more light. But if you want to get film with lower contrast, that's what you do.

Dim lighting conditions, which are often contrasty, are usually shot with pushed film which requires more time in development with a subsequent increase in contrast. That's just what you don't want. This is one of the great difficulties when shooting under reduced light conditions. When some photographers say that a true measure of a film's pushability is its ability to record shadow detail, they are saying, in another way, that the film shouldn't pick up too much contrast when pushed.

This relationship between time in the developer and contrast holds true for negative as well as reversal films, colour and black-and-white films.

FORCED DEVELOPMENT

Filmmakers frequently rely on the lab to push film one or more stops. This is accomplished by increasing the time of development. In the case of negative film, the meaning of this statement is relatively straightforward, since there's just one development step. For reversal black and white and colour emulsions, forced development is accomplished during the first development step. Characteristically, forced development will result in an increase in grain and contrast and, in the case of colour film, shifts in colour values. Such changes in the film's characteristics may be slight or glaring.

In general, the faster emulsions of a manufacturer's line may be pushed at least one stop with only slight changes in quality. Many filmmakers make it a habit of routinely pushing. Ektachrome EF or ECO one stop. Usually, the films that are interesting to push are the very fastest available. There are exceptions. Some people would rather push a slower film than use the fastest available film; the argument put forth is that this gives better results than shooting faster film. This practice is probably based on habit. That's what was done before the fastest emulsions were available, and the filmmaker liked the results, so he continues.

The most important factor involved in determining the quality of pushed film, aside from the film's intrinsic ability to be pushed, is the processing technique of the lab. One lab may do a perfectly fine job of pushing one type of film that another lab will mess up. Typical shortcomings are excessive contrast, a marked decrease in contrast, blotchy development, excessive grain and weird colour shifts. Once again, quality can be judged only by purpose, and one man's poor processing may be just the effect someone else is searching for.

Film is usually pushed in increments of one stop. Departures from expected quality increase the more the film is pushed. After a certain point, reversal may appear to lose contrast. When this happens the blacks lose their fullness, and the image tends to go flat. Some labs are able to push some emulsions one stop (sometime two stops) with very little alteration of quality; Ektachrome EF (in 16 mm, but not in super 8!) is a good example of this. The lab will usually be honest with you about their ability to push a specific film.

Making release prints (not workprints or answer prints) is probably the lab's greatest source of income; but the size of a lab is not an indication of the quality of the prints it can produce.

ANSWER PRINTS - PRINT TIMING

The first print (after the workprint, if any) made from your camera original is called the answer print. Answer prints are prepared with great care in the better labs. A man called the print timer or just timer looks at every foot of your film and selects the proper exposure for printing each shot. This procedure is called timing and grading. The exposure at the time the print is made is controlled by any one of a number of means.

In a typical printing machine there may be two shutters, one controlling the amount of light exposing the film and another controlling fades and dissolves. The shutter which controls the printing light may be very much like a camera's variable shutter. The shutter which controls fades and dissolves may accomplish this by varying its rate of rotation.

The printing machine holds the raw stock and camera original (the term often used for processed camera film) in contact at some point. Here a light is passed through the camera original, or printing master, to control the density of the print. It's exactly like the exposure control exercised in the camera by varying the f stop. A shot on reversal film which has been underexposed and is too dense will require a brighter light than a shot normally exposed. Negative works just the other way.

The rate of the film through the printing machine is usually not varied, only the level of the printing light. Printing machines have a scale of lights, as they are called, in one system ranging from 1 to 21. Every four lights might be equivalent to a stop. For example, two lights brighter are equivalent to an exposure difference of half a stop. Ask, if you want to know more about the system your lab uses. Such information is useful when you get your answer print, if you want further corrections made. It is possible to communicate with your lab like this: make shot (give the footage from the start mark) half a stop lighter or, if you know how the lights work you could say, add two.

The print timer evaluates the proper light by eye. The best light has to be chosen not on the basis of the entire frame, but rather on the most important part of the frame. The timer, in many labs, prepares a punched paper tape to indicate printing lights, fades and dissolves. The tape provides quantitative information about which light and length of a fade but not positional information. The film itself must be notched or marked for positioning of the light change or effect. In one system, metal tabs are clipped to the edge of the film. When the tab passes by the sensor in the printing machine, the information on the tape triggers the light or effect. Other systems cut notches into the film itself; these are sensed by rollers or pressure switches.

No two labs seem to use the same system of lights, coding positional information or preparing the punched tapes. Therefore, a film timed by one lab (the term timed here takes in both lights and effects) cannot be run through another lab's printing machine. For this reason, when changing labs, you have to make another answer print of your film.

Sometimes a film needs no timing changes at all. Others will require extensive correction. Some films must have light changes within individual shots. For example, suppose you panned from a bright to a dark region. The right light for one region is wrong for the other, and a compromise light may look bad, too. One solution is to use a go-to, a change in the light while the shot is being printed. A go-to can be a very successfully employed method; if done well, it is not possible to tell that any timing change is taking place.

In addition to timing and effects changes, the timer may also be responsible for colour correction in the case of colour prints. Such colour correction is in two categories: gross alterations and corrections. A gross alteration would involve an overall tint added to the shot. It might be used to suggest night effects (a deep blue tint) or for sunset effects and so on.

Corrections, as opposed to gross alterations, involve more subtle changes in the shot's colour value. They're primarily used to help match one shot against another. If shooting takes place outdoors over a period of hours for example, the effective colour temperature of the light will vary. Late in the afternoon, the colour of light begins to warm up. Footage shot in the late afternoon may not match footage shot at noon time. The footage shot later in the day may appear to be reddish or orange. Some people like to add correction to the shot with colour correction filters as it is being filmed. However, a colour correction can be done to the shot during printing as well. If you're having reversal-reversal printing done, one cure would be to print the reddish shots with bluish light. For negative printing, you'd use the same general colour.

Colour correction is extremely important when making prints with the negative-positive system. Some labs seem to have a more difficult time making well balanced colour prints with the negative-positive system than the reversal-reversal system.

The timer looks at the footage and decides what correction, if any, is necessary. Some larger labs employ elaborate colour television devices to decide the colour correction to add to each shot. The colour TV systems are vastly superior than doing the job simply by eye. The timer observes the film on a TV monitor, selects the best colour balance by adjusting a set of knobs, and these adjustments are converted to information that can be used by the printer.

Information for colour correction is stored on tape and cued by the film, as was timing information. Older printing machines employ colour correction filters, if colour correction is needed. Newer machines, like late model Bell & Howell printers, have additive colour heads that mix light from three sources to obtain the final printing light. The colour head divides the light from one tungsten lamp into red, green and blue light, then remixes these in any proportion to give a printing light of any desired colour. Printing machines using this system are additive colour printers, since they are adding colour to produce final printer light.

Once all the timing has been done, effects properly placed and colour correction, if any, decided upon, the camera film (A roll, A and B rolls, and so forth) is sent to the printing room, along with the sound track (if any), and a married answer print is made.

PRINT CONTRAST

When we film a subject and accurately capture its range of brightness, the contrast of the subject and the photographic image should match. If there is an equal change in D (photographic density) for a corresponding change in log E (exposure) we'd have a film with unit contrast, or a gamma of 1.0. The ideal reproduction of the subject occurs when we have the Goldberg condition, namely when the combination of print and camera film has a gamma equal to 1.0. The gamma of black and white and colour negative camera film is 0.65. To obtain Goldberg condition prints made from negatives, we'd need a print stock with a higher gamma. The gamma of a print is given as follows:

Negative x Positive = Print

Because projected motion pictures are surrounded by darkness, it has been necessary to depart from Goldberg's constraint which is intended for paper prints.

A motion picture looks like it's got the right contrast if its gamma is about 1.4. Black and white reversal and projection contrast colour reversal approach this gamma. Prints are made from negative on positive stock with a gamma of 2.5 so that we get a print gamma of:

$$0.65 \times 2.5 = 1.6$$

In point of fact the final screen gamma will be closer to 1.4 because of contrast losses in all the optical systems involved (camera, printer and projector).

As far as black and white reversal and negative films are concerned, we have a rationalized or consistent system of materials so that camera films used in conjunction with intermediate masters and/or print film will yield a gamma of about 1.4. This is also true for the colour negative system.

COLOUR BALANCE

As a matter of routine, labs will make colour prints balanced for projection with tungsten lamps. These lamps have a colour temperature of about 3200°K, and they are far and away the most commonly employed in projectors that are likely to be encountered. However, it may happen that your film will be screened with an arc projector with a colour temperature of from 5000°K to 5500°K. If this should occur, such prints will look cool, but usually not objectionably so. A filter, over the projector lens, could be used to warm up the image. If you are making a print that you know will be used essentially for arc projection, it ought to be so balanced.

ANSWER PRINT EVALUATION

Making films necessitates delay of gratification since, unlike a painter, a film-maker can't really see what he's done until the answer print is viewed. When you look at the answer print, you are looking at what you may have been working on for months or maybe years, so it's an exciting and dreadful moment.

Beside seeing how your picture and track work together, you will be looking at a number of technical things (timing, colour balance, etc.), which can get in the way of your being able to appreciate anything else. That's a problem you have to work out for yourself, and time may be the only cure. Before ordering more prints, it may be a good thing to wait and ponder as long as possible.

When you look at your answer print and listen to the track, note whether or not the lab made all of the effects you wanted, the quality of the sound, how good a job of timing they did and, if the film is in the colour, you will naturally be observing the colours.

If the lab has made a mistake, something clearly their fault, like forgetting a fade, they should make all or part of the print over for you. If you have a short film, they may decide to print the entire film. If it's a long film, they may just reprint a section and insert it into the body of the film. The best places to insert footage are where natural breaks occur, such as splice points; and it's probably better to replace an entire head or tail segment than a segment within the central portion of the film. A head or tail segment involves one splice less than footage replaced or inserted within the body of the film.

Once you're out of the answer print stage, you can make release prints which cost less than answer prints. In addition, release prints made several at a time are less are less expensive than prints made one at a time. Labs will usually store the master printing material for you, at little or no cost, so that you can phone in future print orders. You store your master material with the lab at your own risk, so you might consider carrying insurance on films in storage. Labs will not make prints of your film without permission.

OPTICAL PRINTERS

The most frequently used printing machines are continuous contact machines. The master material (that from which the print is made is called the master) and the print film raw stock are held in contact and move continuously past a source of illumination which exposes the raw stock. Another kind of contact printer, less frequently employed, is the step contact printer, which holds each frame at rest for the moment of exposure. Whether the step contact printer yields better prints than the continuous contact machine is open to question. Contact printers are used for the basic bread-and-butter operation of the lab, the making of release prints.

There is another kind of printer, the optical printer, that comes in the continuous and step varieties as well. The use of continuous optical machines is comparatively rare being confined to special applications.

The optical printer is actually a precision-built camera and a projector combination. The projector portion contains the master (often camera original), and the camera portion has the raw stock to be exposed. A lens projects the image of the film on the raw stock. Such lenses are highly corrected, and the mechanism of the optical printer must carefully position both master and raw stock.

There are one-to-one optical printers, for printing one size format to the same size: such machines will print 16 mm to 16 mm, or 8 mm to 8 mm. Reduction and enlargement printers are available for printing from 8 mm to 16 mm and so forth, from one format to another. Optical printing is the only way to accomplish enlargement or reduction from format to format. The following sections describe other uses for the optical printer. The optical printer is theoretically capable of producing the best possible printing masters. Although this is the favoured method for production of intermediate masters (a print from camera film), masters which are made with the finest contact printers produce prints difficult to distinguish from those produced from masters made with optical printer.

RELEASE PRINTS

People desiring the highest possible quality prints may order these produced by the optical printer. Because optical printing is so expensive, compared to conventional contact printing, this is usually confined to the production of short prints, such as television commercials.

EFFECTS

Before the introduction of A and B printing, and aside from effects produced within the camera, the optical printer was used for the production of fades and dissolves - especially dissolves. Optical printers, unlike many continuous contact printers in use, can produce dissolves of practically any desired length. However, this advantage is fast disappearing as late model contact printers offer more varied programs of dissolve lengths and dissolve mixes of various lengths. The use of this optical printer for dissolves (and fades) becomes interesting if one is producing a long film with relatively few dissolves. In order to avoid the process of A and B rolling, it may be desirable to produce effects which may then be cut into the master.

Suppose you've shot your film on Ektachrome EF colour stock and want to make effects to be inserted into the camera film. Set up the footage to be dissolved in the same way that you'd set up the A and B rolls, and then request an optical print with the appropriate effects. Such a print would probably be made on a low contrast high resolution emulsion like ECO which is the perfect material for this use. The effects would then be cut into the camera film master and release prints would be made in the normal manner.

Since the footage which is optically printed and cut into the body of the film is first generation, or one generation away from the camera original, we can expect some changes in quality for these sections in the print. Experience shows that colour shifts, increased grain and contrast build-up are to be expected. These changes can be minimized if the work is done by a good lab. In order to hide the shift in quality, sometimes registered as an annoying pop, print the entire length of the shots going into and coming out of the dissolve, not just the footage immediately adjacent to the effect.

It is possible to produce effects with a contact printer which can be cut into the master for release printing. The most serious disadvantage of this procedure is that the footage must be flopped, that is, inverted right to left, or a mirror image of the shot. Since film can be inserted into the optical printer with either side of the emulsion facing the raw stock, this flopping of optically printed footage can be avoided. I would say that a good effects insert should be difficult to tell from the camera footage in the final print. This wasn't always the case. The superior ECO material and liquid gate printing makes the use of optical effects inserts of interest to 16 mm format users. For production of reversal black and white inserts of this kind, Plus X may serve well. Special black and white and colour internegative materials exist which can be used for the production of negative printing masters from reversal camera footage.

Before you have any optical printing done, discuss the job with the lab. When ordering optical printing, specify what purpose the print will be put to. Like all other instructions to the lab which may be complex or amigious, written instructions are preferrable when ordering prints.

Although the optical printer is used most often for the preparation of masters and effects, it has a number of other interesting applications.

Optical Zooms

Some optical printers can be made to enlarge a portion of a frame, with varying magnification, or reduce the size of the image to a rectangle within the frame. In terms of perspective, such optical printer zooms are identical to in-the-camera zooms.

Frame Line Correction

If two cameras were used to shoot a film, one of which registers the frame at a different position with respect to the perforations, cutting together the footage shot with both cameras will cause an annoying shift of frame line. Frame line correction may be called for. In such a case the master's frame can be shifted in the projector portion's aperture, either up or down, with respect to the position of the camera aperture. The resultant print can have perforations properly juxtaposed with respect to frames (or frame lines, if you prefer this point of reference). The projector crops part of the frame, so it is possible to get away with less than perfect frame line positioning. You may, however, feel that it is necessary to correct gross frame line errors.

Duplicated Shots

You may have occasion to use the same shot in several different portions of your film. One solution is to make a print or prints of the footage with the contact printer, but this will result in the footage being flopped. To avoid this you will want to use the optical printer. If your original was shot on reversal colour stock, ECO is a good choice for your duplicate footage; for black and white, a camera stock like Plus X will give acceptable results. Your lab will probably know the best stock to use for this or any other optical printing requirement.

Hold Frame Printing

Freeze frames, or hold frames, are accomplished this way: one frame is printed over and over again, for as long as required. The effect is to freeze the action. Advice that is often given is to use two adjacent frames printed alternately to suppress grain. If you are alternating rapidly between the two frames, the grain patterns of one cannot be that visible. This is not good advice if the two frames differ drastically, and you may not mind the grain, or in fact, you may want the grainy effect.

Repeat Frame and Skip Frame Printing

If you have got footage that was shot at the silent speed (nominally 16 fps), and you want the action to appear normal at the sound running speed of 24 fps, the solution is to repeat print every third frame. In this case, the sixteen frames of action will take up, or be expanded to twenty-one frames. The method works perfectly for footage shot at today's silent running speed of 18 fps, where printing every third frame will yield 24 fps. Footage which is repeat frame printed may appear to be a little jerky, especially in shots that have a lot of action or camera movement.

Repeat frame printing can be used to create a kind of slow motion effect. For example, if every frame is printed twice, a film shot at 24 fps will now be, in effect, overcranked by a factor of two. Of course, a film that was shot at 48 fps in the camera will have twenty-four new frames projected on the screen every second, whereas a film which has been double frame printed will have but twelve new frames in a second of screen time. The effect of such repeat frame printing is jerky and gets jerkier as you go to three, four or more repeat frames. The peculiar jerky effect may be what you want.

Skip frame printing removes instead of duplicating frames. Film shot at the sound speed can be converted to the silent speed by skipping frames in printing; a reasonably good undercranked effect can be achieved by skip frame printing.

Backward Action

Another obvious use of the optical printer is for the production of backward action footage. The projector portion of the printer simply runs the footage from tails to heads, instead of from heads to tails, making a print on the raw stock as it does.

Other Effects

The optical printer may be used for many other effects, such as wipes, or fancy mate transitions or titles. There are labs that specialize in nothing but optical effects. Liquid gate optical printing is available for suppressing abrasions and scratches on the printing master. It is claimed that the best quality optical prints are made using liquid gate, and some labs recommend its use routinely even if the master film is not worn or scratched.

PRINTS AND PRINTING MASTERS

REVERSAL ORIGINAL

If you have shot reversal, colour or black and white, you can have an internegative printing master made directly from your camera film. Internegative (interneg for short) is the name for negative printing masters made from reversal camera film. (Sometimes the term interneg is used for colour, and dupe neg for black and white. Here we will stick to the term interneg for both.) When the internegative has been prepared, it is used to make prints with the negative-positive system, less expensive than reversal-reversal printing. The sequence, to reiterate, has been from camera reversal to internegative which is used to produce positive release prints.

Many laboratories offer another option for an intermediate printing material when reversal colour stock has been used in the camera: intermediate printing masters on Ektachrome Commercial or Ektachrome R stock. Prints from the master are made with the reversal-reversal system. Some labs use this system because negative colour processing is not available to them. Some people prefer colour reversal printing masters to internegative printing masters because the colours are more saturated and contrast more acceptable. This is especially true when the camera original is a projection contrast film.

BLACK AND WHITE NEGATIVE ORIGINAL

You can have prints made from intermediate masters, if you have chosen to use negative camera film. The situation is a bit more complicated than using reversal camera stock.

If you have shot with black and white negative, the release print system you want to use is the negative-positive. The first thing the lab will make is a master positive (fine grain) print from your camera film. Then an internegative (dup neg) will be made from this master positive. This last step is exactly like making an internegative from reversal camera stock. In this case, however, you had to go one additional step (generation) to get to an internegative. From negative camera film, you have an intermediate high resolution, low granularity positive made, and from this an internegative.

The extra generation here can decide the difference between good or bad release prints, especially if the camera film was exposed less than ideally. Negatives on the thin side will be especially difficult to print after all the generations involved. The extra generation required to get to the internegative stage from negative camera stock is one of the reasons why filmmakers choose reversal camera stock.

One possibility that permits high quality prints is to make reversal-reversal prints from the intermediate positive made from your negative. If the work is well done, they are indistinguishable from original prints. Of course, reversal-reversal release prints are less desirable from an economic point of view than negative-positive.

Another possibility that occured to me was that camera negative might be printed directly on a camera film like Plus X to produce a reversal intermediate printing master. From such a master print, prints could be made with the negative-positive system. I have discussed this with several labs, and they discouraged any attempts. I still think they were being conservative. Gevapan 30 Reversal, because of its low granularity and seemingly lower contrast than reversal of American manufacture, might be the perfect film to try. If you find this idea appealing, I advice that you try a test before going all the way.

Another idea would be to undevelop camera stock like Plus X reversal or DuPont 930A to lower their contrast, making them more suitable meterials for this application.

COLOUR NEGATIVE ORIGINAL

Eastman offers a colour reversal intermediate film, 7249, for the production of negative masters printed directly from camera negative. CRI is a reversal material, but something more was needed than just the idea that negative printed on reversal produces negative. Eastman 7249 has built-in colour masks, just like those in Eastman colour camera stock. CRI has become the standard intermediate material for 35 mm and 70 mm theatrical productions, but it is primarily of interest to filmmakers working in the larger formats since so little 16 mm colour negative is shot. Once a 7249 master has been produced, it can be used to make prints with the negative-positive printing system on Eastman colour positive stock.

Break-even Point

If you choose to have intermediate masters made from camera stock, you may actually save money in the long run. Compare the costs of making prints from your reversal camera stock with prints made from internegative: positive prints are less expensive than reversal.

Another factor to consider is that once out of the answer print stage, optical tracks can be produced from photographic instead of 16 mm mag masters. Prints with optical tracks made directly from mag film, that is, prints which are electro-printed, cost about two cents a foot more than prints made from a photographic track. Therefore, it may be to your advantage to have your mag film transferred to a 16 mm optical track printing master, rather than have release prints electro-printed from mag film.

An additional complication is that you must have an answer print made from your intermediate master just as you had an answer print made from your camera film. Although all the effects may be incorporated into the master, it may still need timing (and perhaps colour correction). If you are lucky, you will get a good print your first time. But then again it may take several answer prints before you are satisfied.

Release prints made from intermediates are designed to be printed on high speed machines without any effects, light changes or colour corrections.

If you take all this into account, it is possible to compute your break-even point, the point after which the intermediate master starts to pay for itself. Suppose you shot reversal camera stock and chose to have an internegative made from it. First you would have had to approve your reversal answer print. Only after approval could you order an internegative from your camera film. The reversal answer print should be perfect before you do this.

If your film was A and B rolled, the internegative will be an A roll. Suppose you choose to transfer your mag film to a master optical track, assuming your answer prints had an electro-printed track. Your film will now be printed from an A roll and a photographic sound track, instead of from the original material which was A and B roll reversal and a mag film track.

The first print made from your interneg and optical track is an answer print, and you will be billed for it at that rate. Once you have approved the print timing, the sound and so on, you can have about a hundred release prints made from an internegative or ECO master before it is worn out.

It is worth making an intermediate master of your camera film? For protecting your original? Economically? Obviously an intermediate will protect your camera film. The second question depends on how much money you have, and how many prints you expect to make. Your break-even point is a function of the number of answer prints you have to make from the camera film and from the intermediate material, whether you have shot in negative or reversal, whether your film was A rolled or A and B rolled, whether or not you will have the track electro-printed or made from a photographic track and so on. Typically, your break-even point may be something like half a dozen prints.

All labs make mistakes. In this respect, they are very much like filmmakers. If you can help it, try to stick with a lab that lives up to an acceptable level of quality, at least for printmaking. If the lab makes mistakes, forgive it if it corrects them at its own expense. A lab that is willing to take responsibility for errors is okay.

If you need a moral, do not live and let live. If the lab makes a mistake, they have to take the responsibility for it. In the same way, you do not want to do business with people whom you feel like taking to court, but if you have to, get an attorney. A threat sometimes does wonders, especially if the going is rough.

Never expect a lab to be able to deliver prints when they say they can. That applies especially to answer prints. Do not schedule screening until the print is in your hands. Bitter experience has shown this to be a good rule.

The general guiding principle then, is to continue to use a lab so that you and that lab get to know each other's idiosyncrasies.

SOUND

Sound has been associated with film from the very beginning. The early films were often exhibited with recording, or musical underscoring was provided by the legendary pianist and even by orchestras. Often primitive sound effects were provided and sometimes the actors stood behind the screen to give voices to the players projected on it. But it was not until the advent of the optical soundtrack that filmmaker were able to manipulate sound with the same sophistication and disciplin that was applied to the visual images.

The invention of the soundtrack not only afforded the filmmaker a more precise control over the relationship between sound image, but also gave him the means for increased complexity and diversity of expression. From the first it was utilized to offer greater reality to the images. Generally sound is *synchronized with the visuals*, that is, it is related to the visual track in such a way that certain sounds are unalterably associated with certain images. Synchronization generally implies a fixed and relatively planned relationship. In its most precise form, it allows for coherence between the movement of the lips, and the sound of the voice, called lip-sync., or in its broader meaning coincidence between any sound and its visible source.

Synchronization need not always be used. In experimental or personal films sound is sometimes not meant to fit the picture in the usual way. It can be employed for example to fill the silence, or to generate a propulsion in sound simultaneous with the propulsion of the visuals. This possibility of freedom and invention is sometimes also employed in the sound track, in the sense, that sound not recorded in the conventional way is used. So sound can be achieved by scratching the sound track, by punching it or by drawing directly on it.

Even if the sound and the picture track are synchronized, sound is not simply an aural illustration of what is seen on the screen. The mutual *interdependence* of aural and visual can be easily demonstrated by applying different soundtracks to the same shot.

For example a shot of a man, standing by a door. The player does not move, his face shows no particular emotion. If these pictures are now joined to different soundtracks, the sound will evoke different responses in the viewers and lead to different interpretations of the shot.

	Sound Track		Possible Responses
1.	Sounds of revelry, singing etc.	1.	The man is going to a party
2.	Creaking floors, owl hoots wind effects	2.	The place is haunted
3.	Shuffling and indeterminate clinking sounds	3.	Mystery - who or what is there
4.	Electronic sounds	4.	The Robots are after him
5.	Heart-beats increasing in intensity	5.	He's expecting someone to jump out and shoot him
6.	A melancholic old song is heard	6.	The man is depressed because he is thinking of something sad in his past

The list of examples could be much longer.

This strong interdependence between picture and sound should be used by the filmmaker, and the inherent expressive potentialities exploited to convey the appropriate mood or feeling.

FUNCTIONS OF SOUND

The relationship of sound or sounds to the visual images can be described as simultaneous or vertical montage, as the addition of notes to a filmic chord written on a horizontal staff representing time. The functions of sound are many.

Sound can define and articulate space, it can describe what is seen in the picture, it can serve as decoration, it can enhance and establish continuity, it can intensify action, movement, mood and meaning, it can comment what is seen on screen, it can reinforce what is seen when used parallel to the picture, and it can also serve as counterpoint.

ARTICULATION OF SPACE

Generally, we do not think of sound as a means of articulating space, although we operate on the assumption that it does so whenever we measure distance or establish position by it, as with an automobile in the street, an airplane in the sky, a voice in a room, or footsteps overtaking us on the sidewalk. Distance, position, direction of movement openness, and closure manifest themselves directly through sound - distance primarily through the relative volume, position and direction of movement through the relative volume in the separate ears, openness by fullness and naturalness of tone, and closure by echo. All of these aural expressions of space have been given greater precision in film by the introduction of stereophonic equipment, which has become especially important in wide-screen projection and in some circumstances would allow us to close our eyes and still be aware of the position of speakers, the movement of characters, and even at times the general character of the space in which they operate.

The spatial implications of voices and natural sounds are familiar enough, as are the sounds of music emanating from a source within the picture space, but background music - that is, music that does not emerge from the action of the film but provides an abstract accompaniment to it - may also suggest spatial ideas in certain contexts. High, thin, brittle, clear sounds seem to parallel our ideas about high altitudes, as if they somehow contained the thinness and coolness of the atmosphere and the clarity of vision, or as if they were simply associated with the idea of high as opposed to low notes on a scale.

Similarly, low, muffled,indistinct sounds are often associated with subsurface depths - caves, mines, cellars, underwater scenes, and the like and perhaps, again, with position on a scale.

Like visual configurations in space, sounds that articulate space may express emotional, symbolic, or intellectual connotations, whether because of their inherent character, their association with familiar experience, or the content of the visual images. The specific implications, of course, always vary with the particular context.

So for example in a shot of man visiting a building, the sound of the leather heels of his shoes and the long echoes which might follow, not only describe the size of the location, but also suggest the building's emptiness. The footsteps seem to say, that this is a cold austere place, that nobody ever visits.

DESCRIPTION

In its simplest manifestation, descriptive sound duplicates or approximates the sounds normally associated with particular things, actions, or milieus. Once a particular sound is established, however, it becomes so much a part of the milieu that we may not notice its absence or rather assume its presence, much as we assume the presence of the harmonica player once he has been heard, even though he may not be seen. In short, the description need not be complete to seem realistic and need not present the actual sounds associated with things and activities at all.

Just as synthetic sounds, abstract sounds and music evoke ideas about space, so too may they imitate natural sound. The ripping of cloth can be accompanied by the sound of a ratchet, the shimmering of an ornamental glass chandelier by the tinkling of bells, smooth-textured surfaces by extended mellifluous tones, the dripping of water by a plucked string. Some associations between synthetic sound and image have been used so frequently that they have become cliches, like the full symphony orchestra with all its suggestion of density, mass and power in repeated crescendos accompanying the crashing of waves.

In principle, on an abstract or conceptual level, certain qualities of sound may be identical with qualities of physical materials or of actions; for example, smoothness implies unbroken continuity, which may exist either in space or in sound. Synthetic sound may thus isolate a quality for emphasis and therefore be more effective in a particular context than natural sound.

DECORATION

Whatever other function it performs, almost any sound track can decorate or embellish the film by lending audible sensuous delight to the visuals and providing a feast for the ears. In its most obvious usage, decorative sound often accompanies banal travelogues. Though it may provide a rhythmic propulsion lacking in the action and the cutting, it seems mainly to provide sensuous activity for the ear. As nature abhors a vacuum, the reasoning goes, the human ear abhors silence. Decorative sound becomes a raison d'être in musical comedy, of course, with the forward thrust of the narrative halted from time to time to allow soloists, chorus, and dancers to perform.

Aural decoration is not limited to music.

Nonmusical sound can have its own sensuous appeal - the whine of a racing car, the clop of hooves on cobblestones, the rustle of shirts. But the decorative use of sound implies conscious and deliberate selection, isolation, emphasis, and ordering, so that the sound is apprehended as something more than the normal accompaniment to an act or milieu or, in dialogue, the normal pattern of speech.

Also sounds of ordinary speech can be orchestrated and so transformed into a form of song or rhythmic pattern. In short, it is when the sound has aesthetic integrity apart from its space-articulating or descriptive functions that we can think of it as decorative.

CONTINUITY

The use of musical accompaniment in the days of the silent film was calculated to establish and parallel mood, to support dramatic intensification, to reinforce climaxes, to substitute for sound effects, but, in large part, to enhance the sense of continuity in the visual track by maintaining a continuity in sound. Anyone who has watched a film projected first in silence and then with piano accompaniment will recall that the continuity seemed smoother and the cutting less abrupt when viewed with music, as if aural stimulus somehow synesthetically produced optical response, and the sound of music reduced the visual shock of the cut. Sound has continued to smooth transitions ever since.

Continuity of the sound track involves something more than creating an aural linkage from shot to shot. For the rhythmic ordering of sounds lends its own impulse to the film: the drip of water, the beat of the heart, the pulse of the engine, the patterns of speech, the synthesized sounds of music carry the spectator along in varying rates of celerity, sometimes accentuating the rhythm of the visuals, sometimes establishing counter-rhythms, sometimes carrying the forward thrust of the film almost entirely and imparting an order the visual track itself may not possess. Thus momentarily and without thinking we may attribute to the visuals a quality of excitement or of unity residing only in the sound. Carefully integrated with the picture and extending the force of the visuals into another dimension, sound can give support to the pulse of the action, varying its meter while holding its beat, investing it with particular emphasis, expanding its import with gross distortions or subtle shadings. When most completely integrated, the sound - whether it is speech, sound effects, or music - will not simply further naturalistic description or, in the case of music, carry on in the background of the spectator's attention but will be united with the picture to form an organic whole in which both elements are indispensible.

The coincidence of visual and aural rhythms can be carried to a point at which the relationships seem mechanical and forced, however, as when the rhythms of action and of music are absolutely matched or synchronized.

This effect appears frequently in some of the earlier animated cartoons, from which this method acquired its descriptive term "Mickey Mousing".

While such relationships can be used to advantage, especially for comic effects or for reinforcing climaxes, they tend to seem banal and monotonous when carried through the length of a piece.

The same principle that applies to the establishment of visual continuity applies in the use of sound. Only the terms are different. Likeness in one aspect or another of the sound reinforces the sense of continuity, such as likeness in tone, overtone, pitch, key, volume or rhythmic pattern.

Methods of transition similar to those employed for the visual track can be used in sound as well and with much the same effect. These include the abrupt cut, the fade, and the dissolve. As with the direct imitation of visual rhythms by sound rhythms - and vice versa - such transitional devices may coincide with the effect in the visual: sound may be cut or may fade or dissolve with the visual cut, fade or dissolve. But as a rule, sophisticated filmmakers will take advantage of the fact that they are using two tracks and, while maintaining a relationship between them, develop each freely so that they reinforce each other in a more subtle way.

So for example a shot which is relatively static might be accompanied by a sound which will carry the film forward on a more rapid beat than the cutting. Or transitions from one sequence to another may be accompanied by a sound bridge in which the sound will be carried over a visual cut, fade, or dissolve, not imply to link one sequence with another, but to urge it forward. Such a bridge may carry the sound of the first sequence into the second or initiate the second before the first has ended. So for example the transition from a quiet dialogue to a noisy crowd scene introduces the sounds of the crowd before the dialogue has ended. The device therefore functions not merely as a means of attaining formal continuity, but also to clarify the narrative, for it expresses in the first scene an idea that the second scene illustrates visually.

In the composition of the images, particular forms can be used, not only to provide continuity from shot to shot and from sequence to sequence, but also to reinforce a sense of relatedness among larger segments of the film or throughout the film as a whole. As with the repetition of visual motifs, the repetition of particular sound or sounds will have the same effect.

The most familiar example in this respect, is the repetition of the musical theme. The musical theme might be repeated in different contexts and so may create connections between distinct shots. It can also be used as a tonal center around which the other music is made to revolve.

INTENSIFICATION

The sound track may carry much of the burden, if not the entire burden of dramatic intensification. Of course, this can occur through the literal context of the narration and dialogue or the descriptive content of action that involves sound.

Generally, of course, we are concerned not only with the meaning of words, the identification of natural sounds, and the presence of music, but with their tone, pitch, timbre, volume, continuousness or discontinuousness, and the way in which they are ordered in relatively simple or complex patterns of changing accent or meter, gathering force and discharging it. Intensification may occur in progressive change. It may also occur through simple repetition. In each case, intensification is the product of contrast. Repetition of a phrase normally is in direct contrast of the normal flow of the language. Contrast can be equally expressive, if the progression leads to relative quietness. So for example the music performed by an orchestra may die out raggedly, and the silence which follows will lead to more attention for what is going on on the screen, than the continuous flow of music would have achieved.

METAPHOR

Like the visual image as a whole and like for example colour, sound can be used metaphorically.

This means that for example music which is normally used in special context, can be applied to a quite different content and so lending ideas or specific associations to a scene. So for instance a music which is normally related to ecclesiastical or religious motifs, applied to a scene showing more worldly things, will condition the perception of what is shown in a specific way.

EVOCATION

A musical theme may become a kind of geographical sign in and for a specific film. If for example a melody is well established in a film and has been connected with certain associations, it will not only enhance the unity of the film, but will carry its own meaning. If it is then repeated in different contexts, it will not only connect distinct shots or events, but will recall by itself, events and assocations, moods and feelings.

COMMENT

The sound track obviously lends itself to direct verbal comment. The most common example is the instructional or documentary film with its typical voice-over narration. But also in feature film voice-over narration is used. Here it could be the analytical reflections of an observer who is somewhat removed from the events or the meditations of one of the main characters, who might reveal in interior monologues things that are hidden in his face or behaviour. In both these cases the narrator maintains distance and speaks as if the audience is not present. But the narrator may also address the audience directly, making comments on the action much as the narrator of a documentary might.

PARALLELISM

Parallel sound imitates, reinforces or intensifies the visual or dramatic content and the formal rhythms of a film. Music which in its tempo, rhythm, accent and chordal progression is parallel to the visual patterns and the beat of the cutting. Gaining in volume and fullness it can parallel and reinforce the climax of a sequence for example.

But paralleiism is not only found in music. So for example the shocked response of a studen about what the teacher is telling him, could be underlined by the ringing of the school bell which starts in just that moment.

Parallel sound supports and makes explicit the content of the visual image. Parallel sound, no matter from what source must be handled carefully. It can be developed to a point where it seems forced, and would create a Mickey Mousing effect.

Certainly the most provocative use of sound seems to have been developed in sound counterpoint.

COUNTERPOINT

Contrapuntal sound allows for a greater expansion of the filmic statement, for the expression of more complex ideas and feelings, and for the introduction of tones and overtones that the visuals may not convey. It permits the introduction of infinitely varying and subtle shades of meaning, and, in the simple contrast of aural and visual rhythms and accents, it augments the filmic tension. Even the simplest contrast between sound and visual image will have at least the minimal effect of making one the foil for the other and thereby of heightening the effect of the other.

A suggestive example of such a treatment is a film on a wrestling match. The camera work shows the massiveness of the figures, the agitation of the spectators, the harsh contrast of the ring lights in a style that evokes images of suppressed human brutality which is released either directly or is acted out for the audience through the performers at this event. But the sound track does not produce the shuffling of shees, the thud of bodies, the grunts and groans of the fighters or the shouts of the crowd, instead, it unrolls the light, gracious and elegant notes of a classical piece of music.

If the simultaneous presentation of two such disparate collections of ideas and forms has the immediate effect of comedy, the inherent incongruity also intensifies the sense of brutality and violence in wrestlers and spectators alike.

Conversely, it may have its source completely outside the space described by the visuals, as in background music or in the words of a person not participating in the action - a narrator describing a documentary, for example. In this case we think of the sound as external.

In early experiments with sound, filmmakers sometimes played with the sound track in such a way as to deliberately confuse the audience about the source of the sound, introducing what seems like background music and then, after a time, surprising the spectator by revealing a source of that sound within the narrative space, as if mocking the more conventional use of musical accompaniment.

These experiments seem to imply an inherent ambiguity about music and sound. Is it external, until the source is identified in the picture and external as soon as it disappears from the image? In a filmed conversation, when the attention shifts from the speaker to the listener in either a cut or a movement of the camera, does the sound shift as well from external to internal? If we keep in mind that filmic space is not simply the space described by the lens of a stationary camera but the space described by a camera in motion or by separate shots arranged in a series as well, the problem does not arise. In this sense music can serve as a means of expanding the filmic space beyond the visual space.

A similar question may arise concerning the relationship of film sound to film time. Although most of the sound is synchronized with the visuals and therefore is apprehended synchronously with them the content of the sound may be such that we identify it as taking place simultaneously with the action or as occuring at another time. Sound that is obviously internal - that emerges from the action, words spoken by lips we see, and [illegible] words spoken and music played by persons we do not see but know to be present - is synchronous. Although they may be apprehended simultaneously with the visuals, sound flashes backward or forward imply a different period of time and are regarded as asynchronous. Sound bridges that carry sound associated with one scene over into another or introduce the sounds of a succeeding scene before the preceding scene is ended may be synchronous or asynchronous depending on the context.

Somewhat less directly it suggests the notion that wrestling is an art form rather than a sport and that its social function is the sublimation of violence.

In a sequence of Godard's film 'My Life to Live', picture and sound are contrasted in a similar though more subtle way. The camera shows what is seen out of a car when driving through the center of Paris in the late afternoon. The soft diffuse evening light combined with the glow of street lamps, all the lustrous patterns of light and dark which makes the center of Paris so attractive. At the same time, inside the driving car, a pimp tells Nana about her future life as a prostitute.Furthermore he recites in a flat unmodulated voice as if reading from a police report. The arid monotone of his speech contrasts with the seductive and chanting visual patterns, laying bare the methodical operation of vice behind the glamorous facade of the city and transforming the romantic excitements of love, and as well the dangers and degredations of prostitution into a routine matter.

Silence too, can act as a counterpoint. So for example when a women suddenly overwhelmed by the horrors of her existence screams like a wounded animal, over and over, body rigid, face contorted, mouth gaping, but no sound is heard. The shock of the silence may tell more of her anguish than the loudest scream could possibly reveal.

INTERNAL, EXTERNAL, SYNCHRONOUS AND ASYNCHRONOUS SOUND

So sound can in many ways simplify or amplify the content of a film. It can increase its complexity, reinforce its structure, and it can also take an independent course. But unlike colour, which might function in much the same way sound does in relation to the picture, sound is not an integral part of the image, but is a separable element. It can emerge from the space or action described in the visuals, as when we hear and see a person walking or a dog barking, when trees rustle, waves break and trains roll. In these cases sound is internal.

If the bridge leads from one scene to another taking place simultaneously, it may be regarded as synchronous: if it leads to events taking place at another time, it may be regarded as asynchronous.

But what about background music or voice-over narration of someone not involved in the action?

These sounds describe the visuals, comment on them, clarify their meaning or are intimately related to them in one of the ways explained above.

Therefore if one thinks in terms of the aural-visual chord, rather than the process; of the reality of the work of art rather than the reality of everyday existence, such sounds can be considered synchronous. So the traditionally filmed dialogue can be regarded as synchronous and internal sound, whereas voice-over narration is synchronous and external sound.

Considering sound in this way, we can discover four basic types of relationship between the sound and the visuals. The sound may be:

1. Synchronous and internal (sound emerging from the action)

2. Synchronous and external (background music and voice-over narration)

3. Asynchronous and internal (flashback, flashforward, interior monologue)

4. Asynchronous and external (sound bridges, sound dissolves)

SOUND RECORDING

THE NATURE OF SOUND

Sounds are produced by vibrating bodies which cause vibrations in the molecules of an elastic medium, usually air. When, for example, a tuning fork is struck, it vibrates and adjacent molecules of air are set in motion causing a wave or signal of sound to propel outward from the point of origin, just like ripples produced by a stone dropped into water. Sound waves are not visible, and unlike water waves, they do not exhibit hill-and-dale wave motion.

Sound waves are made up of regions of rarefactions and compressions of air of varying pressure. When the air molecules are piled up against one another, the sound wave is under compression; when the pressure is reduced, we have what is called the rarefaction.

The number of rarefactions and compressions which pass a given point in a certain time is known as the frequency of sound wave. For example, one thousand pairs of rarefactions and compressions, or one thousand waves, passing a point in one second has a frequency of 1000 cycles per second, i.e. 1000 Hz because frequency is measured in Hertz. The distance between the maximum compression (rarefaction) to the next compression (rarefaction) is the wave-length. Frequency and wavelength are inversely proportional. The human ear can hear a frequency from about 25 to 15,000 Hz. A doubling or halving of a frequency is equivalent to raising or lowering a note of music one octave. For example middle C is 256 Hz., high C, one octave higher, is 512 Hz.

The physical quantity frequency is directly related to the psychological variable pitch. Sounds with a high frequency have a high pitch; sounds with low frequency have low pitch.

All sounds are not simple, smooth sine wave. An instrument that plays a note of a certain pitch has what are called harmonics, which are simple multiples of the frequency of the note. But sounds which are recorded will often be the sum of many sources of sound and the waveform of those combinations can be extraordinarily complex.

The amplitude of a wave is a measure of its maximum displacement. The height of the wave above the axis, is its amplitude. The amplitude of a sound wave is, in psychological terms, its loudness or intensity. Actually, the terms intensity and loudness should not be confused, because doubling the amplitude may double the intensity of the sound, but not double the loudness as perceived by a listener. Intensity of sound is measured in decibels, a measure of power per area; a doubling in loudness, as perceived by a listener, is equivalent to a rise of three decibels (dB).

The ear's sensitivity to sound varies with the frequency or pitch of that sound, and it is most sensitive to sounds in the region of 2000 to 4000 Hz. The ear is sensitive to an extraordinarily broad range of sound intensities. The range of sound the human ear is capable of hearing covers about 120 dB. Practically speaking, it is very difficult for sound recording techniques to encompass the full dynamic range of the human ear. For example, the dynamic range of a symphony orchestra is about 70 dB. Unfortunately, even this range is difficult to record.

In any sound recording there is a certain amount of inherent system noise. Such spurious sounds are generated in the electronic equipment itself and also by unwanted sound recorded at the time of the taping. The specific medium of the recording will also limit the dynamic range: magnetic recordings are limited by tape noise, or hiss. Such low level noise in the recording and reproducing systems limit the level at which soft sounds may be recorded.

Similarly, there is an upper loudness range: if sound is recorded at too loud a level, the recording will be overloaded - the sound will be distorted. As it turns out, recorded sound is usually limited to a dynamic range from about 30 to 50 dB.

MAGNETIC RECORDING

Recording for motion picture work is usually done on quarter inch magnetic tape.

Magnetic tape is capable of making recordings that closely approximate what the ear needs to hear to make sound natural. The tape easily reproduces the full frequency range of human hearing. Magnetic tape also reproduces a good dynamic range with little distortion. Moreover magnetic tape may be erased and used over indefinitely and recordings may be played back immediately after recording. From the standpoint of the filmmaker it is important, that magnetic recordings can be duplicated or dubbed with relatively little degradation, though this is no excuse not to make the best possible recording.

Magnetic recording tape is made of plastic material, acetate, polyesther, PVC, etc. coated with a preparation of iron oxide. The standard thickness of the base is 1.5 millimeters. With this thickness the standard size seven-inch diameter reel can hold twelve hundred feet of tape, or, 7½ '' per second (ips) a little over half an hour of recording time. When the total thickness of the tape is less, more will fit on one reel. This principle enables manufacturers to produce what is known as "long-play" or "extra-play" (the terms vary with the manufacturer) tape. The thinner extended tapes have several disadvantages for the filmmaker. They are not suitable for high quality sound recording at high running speeds, they tend to stretch, because the material of the base is different from that of the standard size tape and they are not easy to handle during editing.

THE TAPE RECORDER

The tape recorder consists of an amplifier, which amplifies the signal received from the microphone to a degree sufficient enough to activate the recording process. The recording is done by the recording head. This is a small electromagnet, which consists of two C shaped parts, facing end to end with a very fine gap in-between. Both C shaped parts are wrapped with a coil of wire on their sides. When the signal from the amplifier is fed to the coils, the fluctuations in the signal current cause changes in the magnetic field around the gap. When the moving tape passes by the head in front of the gap, the iron oxide layer of the tape is magnetized by the magnetic field of the head in varying degrees according to the fluctuations of the magnetic field. The iron oxide remains magnetized for a long time and stores in this way the original sound, which has been converted from mechanical (sound wave) to electrical (signal of the amplifier) to magnetic energy.

Replaying is the reverse of the recording operation. The tape already magnetized, is drawn across the head, and the changes in the magnetic field on the tape induce varying currents in the coils of the head. The current thus induced are amplified and fed out to the loud speaker, which in principle is the reverse of a microphone, and which converts the electrical impulses to sound waves.

With most amateur machines, the recording head also works as the playback head. In many professional tape recorders, separate heads for recording and replaying are used, because for best results, the width of the gap of a playback head should be one tenth of the width of the recording head.

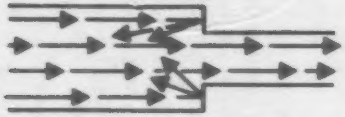
Recording heads can be of different configuration. The most popular head configuration for home recorders is the four track system. Here the head magnetizes only one quarter of the tape width while it moves across the gap. This means that the recorded area is smaller i.e. more than one channel of information may be carried on the tape. This is definitely the most economical way of recording but does not yield the best results.

There are also machines with half track heads, i.e. the recorded area covers half of the width of the tape. The wider the head, the more it can magnetize the tape, the effective dynamic range is reduced when progressing from full track, to half track to quarter or four track. Also the smaller electrical signal on two or four track, will need more amplification during playback. The less amplification, the greater the separation from background noise.

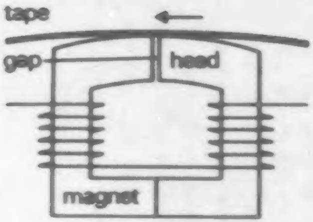
Professional quality recorders therefore normally use either full-track recording or half track, which still gives a good signal-to-noise ratio but is more economical with tape, since each reel is used twice along its length.

In the typical *transport system*, the tape travels from the feed reel to the head, past the capstan and the pressure roller to the take-up reel. The tape must be driven at a precisely *constant speed* past the head, otherwise when played back, the sound will be distorted. The resulting changes in pitch are called *flutter* for the high frequencies and "wow" for the low ones. (That the tape runs at a constant and steady speed). The *capstan* and the *pressure roller* assure that the pressure roller presses the tape against the rotating capstan, which drives the tape at a controlled speed independent of the varying winding rate of the take-up reel. Some tape recorders use one motor to drive feed reel, capstan and take-up reel, others may use one motor for each.

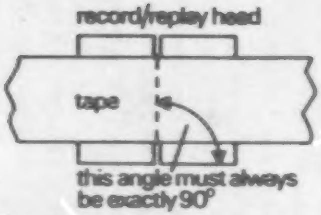
The tape must be driven past the head at a constant speed for each recording. But for different recordings the running speed can be different, depending on what should be recorded. The faster the tape travels, the higher the frequencies that can be recorded. Standard *running speeds* are 1 7/8 inches per second, 3 3/4 ips, 7 1/2 ips, 15 ips and 30 ips. For very high quality recording, for example for music, 30 or 15 ips may be used, but for normal film work 7 1/2 ips is used, which still gives very good results. For voice recording sometimes 3 3/4 ips may be used. The principal advantage of using a slower tape speed is economy. The faster the tape travels through the machine, the more tape is used for one recording. The use of a very high running speed would also mean, that tapes would have to be changed frequently when using a small portable recorder for example for location work. Furthermore, editing is easier, when the amount of tape is less.



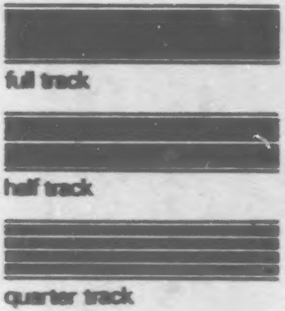
Impedance: the analogy with a water-pipe.


tape
gap
head
magnet

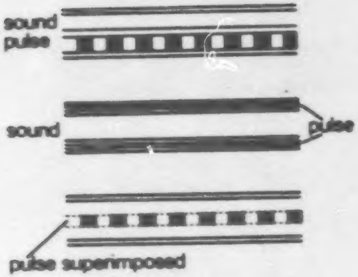
Record/replay-head.


record/replay head
tape
this angle must always be exactly 90°

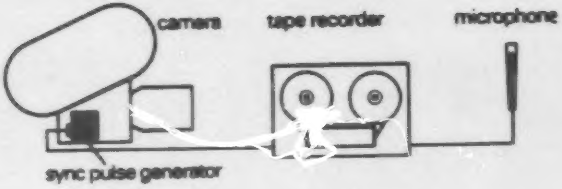
Azimuth: the angle between the gap of the head and the direction of travel of the tape.


full track
half track
quarter track

Track configurations for ¼-in. tape.

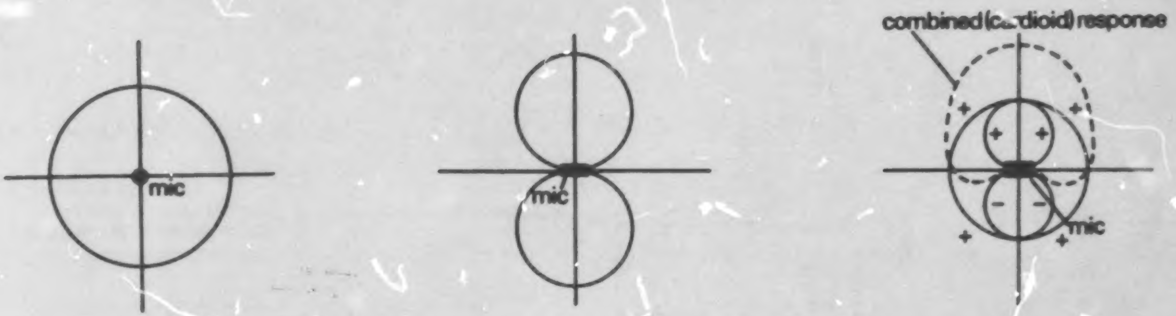

sound
pulse
sound
pulse
pulse superimposed

Different sync-pulse layouts.


camera
tape recorder
microphone
sync pulse generator

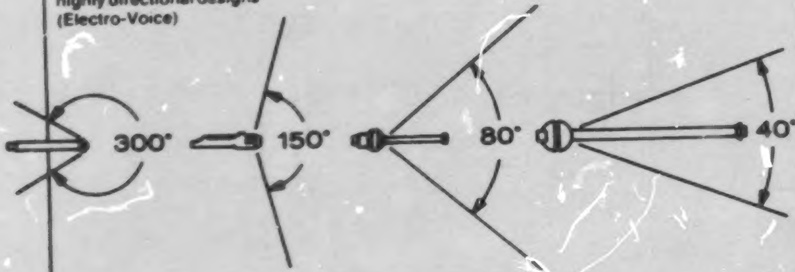
layout for pulse-sync recording

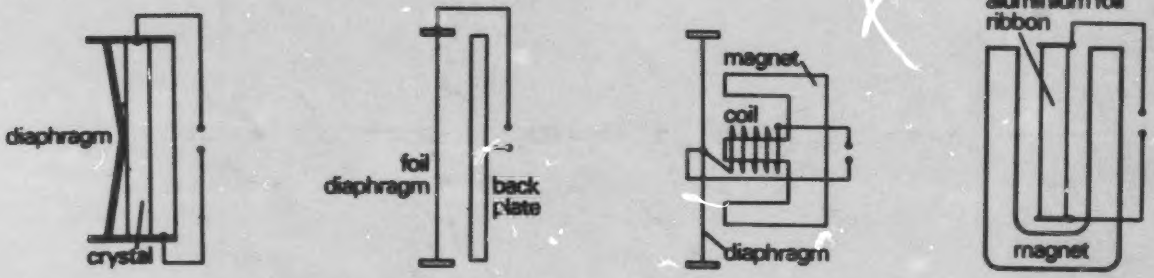
Sync sound recording


mic
mic
combined (cardioid) response
+
+
+
+
-
-
+
+
mic

Polar diagrams for omnidirectional (left); figure of eight (middle) and cardioid microphones (right)

Acceptance Angle. Four microphones and their coverage. They progress from nondirectional to highly directional designs (Electro-Voice)




diaphragm
crystal
foil diaphragm
back plate
magnet
coil
diaphragm
aluminium foil ribbon
magnet

The four main types of microphones: (Reading left to right): crystal microphone, condenser microphone, moving coil or "dynamic" microphone and ribbon microphone.

With tape recorders the main distinction is between reel-to-reel and cartridge machines. Today many cartridge recorders are capable of making very good recordings. Their main advantage is that they can be loaded instantly and that they are small, in most cases easy to carry and that they can be easily concealed, which might be important for some type of documentaries. Their most serious disadvantage from the filmmakers' point of view is, that cartridge material is difficult to edit. Naturally it is possible to re-record or dub cartridge material to reel-to-reel tape, and cut it then, but to achieve highest quality, it is undoubtly better, to edit the original and to avoid too many transfers. Sound for film has to be copied serveral times and each duplication degrades the quality of the material especially the high frequency parts of the audio spectrum. Therefore cartridge machines should only be used, when reel-to-reel machines are not advisable.

The other important feature of tape recorders is, if they are portable or not. Portable machines use batteries or rechargeable power cell, while the not so portable ones use line current. With real portable machines, recordings can be made anywhere as long as they can be transported.

MICROPHONES

The microphones is a device for converting sound waves into electrical impulses. Microphones can be divided into two basic categories, according to their directional response i.e. the direction from which they pick up the sound, which is inherent in their design. The directional qualities of microphones can be roughly compared to lenses of wide angle, normal and telephoto focal lengths. The two types are: Omnidirectional, which are sensitive to sound waves coming from all directions and figure-of-eight microphones, which are sensitive to sound waves only in front of or behind them.

OMNIDIRECTIONAL	FIGURE-OF-EIGHT
Crystal	Ribbon
condenser	
moving-coil (dynamic)	

Crystal microphones. Certain crystals, when compressed or distorted emit electrical impulses in proportion to the amount of distortion. In a crystal microphone, the diaphragm is deflected by the pressure of the sound waves, and in turn compresses the crystal, either by direct contact or by air pressure. Since this microphone is activated by pressure, the response is omnidirectional.

The crystal microphone is always high impedance, and is rarely used for work of a professional standard: it is mainly confined to the amateur market.

The *condenser microphone* is fed a direct-current voltage; the sound waves cause the foil diaphragm to fluctuate, and the capacity of the condenser formed by the foil diaphragm and the back-plate changes according to these fluctuations. The changes in the condenser produce changes in the applied voltage which is fed to the amplifier. Again, since this microphone operates on pressure, its response is omnidirectional.

In *moving-coil* or *dynamic microphones* the movement of the diaphragm causes a coil to move along the magnetic field of a permanent magnet; this induces a varying current in the coil in proportion to the pressure of the soundwaves. Again, this microphone is omnidirectional.

Ribbon microphones constitute the majority of figure-of-eight mikes. A foil ribbon is suspended in the magnetic field of a permanent magnet, and vibrates in accordance with the sound waves that fall upon it. This movement within the magnetic field induces a varying current in the ribbon, which is in turn fed to the amplifier. Since this microphone works on pressure gradient, i.e. the difference in pressure in front of and behind the ribbon, the response is along one axis only, and falls in a figure-of-eight on the polar diagram.

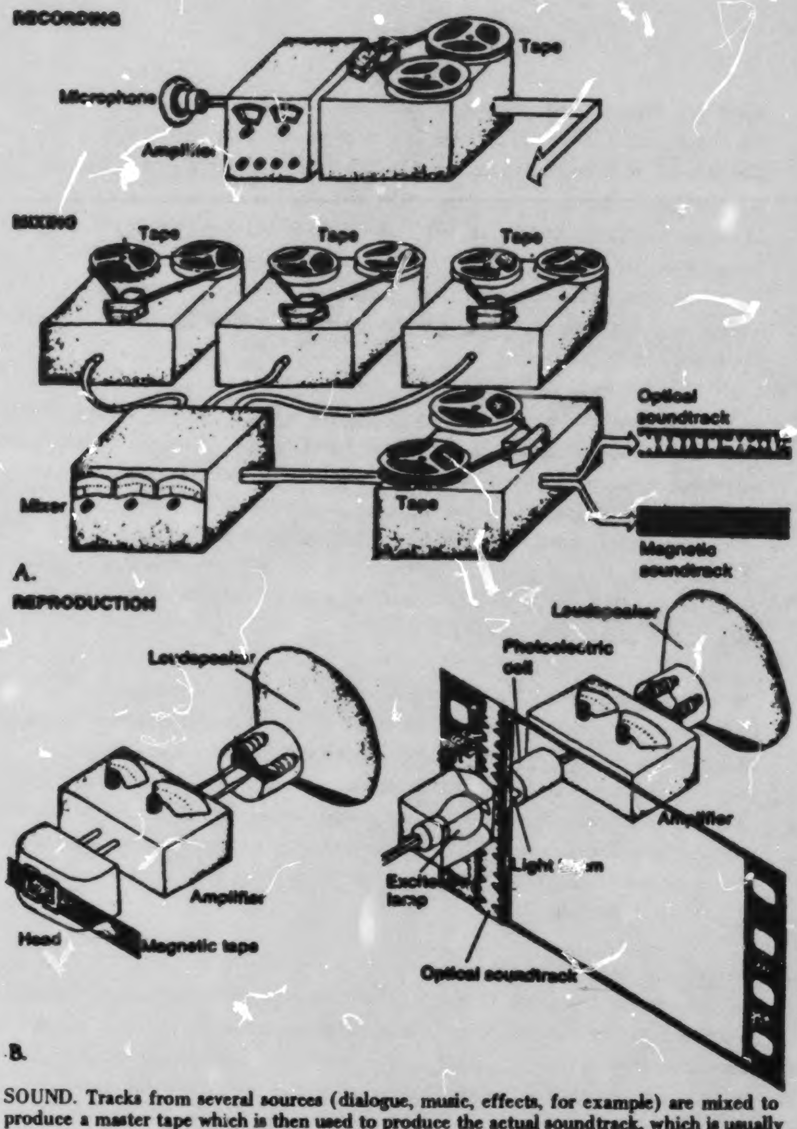
The ribbon microphone is very sensitive indeed, and can sometimes be over-sensitive to sharp sounds; it may not, for instance, be suitable for recording speech from a close range.

A further type of response can be obtained by a combination of an omnidirectional and a figure-of-eight microphone. This produces a unidirectional microphone, which dervies its usual name, cardioid from its heart-shaped polar diagram. This works because the response behind a figure-of-eight microphone is 180° out-of-phase with the response in front. When this is combined with an omnidirectional response, which is in the same phase all round, the responses behind the microphone cancel out, and thos in front add, giving the characteristic heart-shaped response.

It is also possible to make combined microphones: these have three-way switches giving the option of omnidirectional, figure-of-eight or cordioid responses. Even more directional responses than those obtained with normal cardioid microphones can be arranged, for example with either 'rifle' or shotgun microphones - often cardioid microphones fitted with a tube to reduce the area of response to the minimum - or with microphones situated at the focus of a parabolic reflector which reflects sound waves back to the microphone itself.

There are other types of microphones, which also work according to one of the designs mentioned above, but which are used for specific purposes. As for example, the Lavalier microphones which are moving coil mikes. They do not give such good results as the normal dynamic microphones but have the advantage, that they can be placed nearer to the source of sound, than is normally the case. They are used mainly in documentary films and can be either hung around the neck or attached directly to the clothes of persons interviewed.

Microphones will be either of a high or a low impedance and it is essential to know which. Impedance is a fairly involved subject, but can be loosely described as the resistance presented to an alternating current. As the impedance affects the amount of current carried at any given voltage, it is very important to match the impedance of the microphone to that of the recorder input. The classic analogy with the water-pipe will make this clear. The diagram at the end of the chapter shows the principle.


RECORDING
Tape
Microphone
Amplifier
MIXING
Tape
Tape
Tape
Optical soundtrack
Mixer
Tape
Magnetic soundtrack
A.
REPRODUCTION
Loudspeaker
Photoelectric cell
Loudspeaker
Amplifier
Light beam
Exciter lamp
Amplifier
Head
Magnetic tape
Optical soundtrack
B.

SOUND. Tracks from several sources (dialogue, music, effects, for example) are mixed to produce a master tape which is then used to produce the actual soundtrack, which is usually optical, sometimes magnetic. The magnetic track is read by the miniature electromagnetic "head" which senses variations in the magnetic signal. The optical soundtrack is read by a photoelectric cell which senses variations in the amount of light transmitted through the soundtrack. The exciter lamp is the uniform light source.

The water represents the electric current, the width of the pipe the impedance, and the eddies in the water flow represents distortion. The current flowing through the wide pipe (low impedance, letting a large amount of current through) comes to a point where the size of the pipe is reduced considerably (high impedance, capable of bearing only a part of the current at the same rate of flow). The only possible result is that some of the current must eddy back, and this causes distortion in the current, and thus, in a recording set-up, distortion of some kind in the signal fed from microphone to recording-head.

Most professionally used microphones are of a low impedance, and these have the advantage that they can be used with a long length of cable between microphone and input without signal fall-off (some portable recorders, particularly, do use high-impedance microphones); it is essential that low-impedance microphones be fed into low-impedance inputs. If a low-impedance microphone is to be used with a high-impedance input, a matching transformer must be used to adapt the current flow. In some set-ups, such as a Reslo 50/60 ohm low-impedance microphone used with a Ferrograph recorder, an adaptor is available to fit directly on to the microphone cable; otherwise the cable must be plugged into the transformer, and the transformer to the recorder input. Failure to match impedances of equipment will result in loss or distortion of signal.

Since few tape recorders have inputs for several microphones, if more than one microphone formonoaural recording should be used, a mixer is also necessary. The microphones are connected to the mixer which is connected to the input of the tape recorder. So it is possible to raise or lower the level of each microphone so that the signal being recorded is the best possible combination of all the microphone signals.

Some mixing units offer more than simple volume control; they may have the ability to alter the high or low portions of the audio signal of any one of the microphones. Attenuation of the low frequencies, for example, from below 200 to 100 Hz, often improves speech recording because low frequency background sounds are suppressed.

So there are three stages and three items of equipment in the tape-recording layout: the pickup of the signal and its conversion into electrical currents (the microphone); the amplification of the signal to a degree at which its effect can be conveniently recorded (the amplifier); and the recording itself (the recording-head).

Each part of this chain is essential and the quality of the recording can only be as good as the quality of the worst piece of equipment. If a poor microphone is used, for example, the recording will be correspondingly poor,no matter how excellent the amplifier and recorder.

SYNCHRONOUS SOUND RECORDING

All the above descriptions and remarks apply equally to all kinds of sound recording for every purpose. There is a peculiar consideration, however, which arises only in connection with film work - that of keeping the sound recorded in synchronization with a moving picture being filmed. Since magnetic recording tape stretches, slips and so on, it is not sufficient merely to record the sound at the same time as the picture is shot: on replay the variations in the physical condition of the tape, together with mechanical variations, however slight, on the different pieces of equipment used, will mean that exact synchronization will be lost very quickly, and especially with voices on screen, the sound will be unusable. Various systems are therefore used in much film sound work to keep film and magnetic ¼'' tape together during shooting, so that the sound can be fitted exactly to the picture. This process is called synchronous sound recording or, more usually, shooting sync.

Synchronous sound recording can be subdivided into two categories: ¼'' systems using ¼'' tape, and systems using 16 mm magnetic film. One way of recording sound synchronously with the picture is to use perforated ¼'' tape on a special recorder. The drive of the tape recorder is linked to that of the camera, either mechanically by a flexible drive cable, or electrically, and the tape is driven by sprockets, rather than the usual ¼'' capstan drive system. This system is in fact now virtually defunct, and the more versatile pulse-sync system is now practically standard.

The pulse-sync system uses an almost standard ¼'' tape recorder, and the variations in the speed of the tape caused by stretch and slip, which would normally cause the sound and picture to lose sync, are dealt with by recording on the tape, along with the sound, a pulse generated by the camera itself. The tape is replayed on a variable-speed machine, and its speed varied to keep the pulse constant. This ensures that when the sound is transferred to 16 mm magnetic film for editing, the sound is exactly synchronous, frame for frame, with the picture.

The pulse-sync system has several advantages over all other systems. Perhaps the chief of these is convenience: the lightness of the equipment, its portable construction and battery operation make location sync shooting a relatively easy task. Long cables can be used, making it possible for camera operator and recordist to remain some distance apart; in some systems there is no direct link between camera and recorder - either a common pulse-generator can be used, or the crystal sync, operated by matching crystals in both camera and recorder which oscillate at precisely the same rate: In this case no link at all is required between camera and recorder.

Other advantages of pulse sync include cost - compared with 16 mm sepmag. systems, both equipment prices and running costs are low - and quality: the separate ¼'' magnetic tape system of recording produces the highest-quality results available.

16 mm magnetic film systems can be subdivided into 'commag'. (Combined magnetic sound) and 'sepmag' (separate magnetic sound). In the commag. system the raw filmstock used has a magnetic stripe on the non-sprocket edge. The film passes through the camera gate and then on to a recording system which puts the sound signal direct onto the stripe. The film then returns to the take-up spool. Only the recording-heads are placed within the camera body: the microphone and amplifier are carried by the sound recordist, and the signal fed into the camera input.

The main use of this system is for news or interview work, where speed of processing is the main consideration. Master material shot in this way can be edited directly, and projected with sync sound without delay for transfer and dubbing processes. The main disadvantage of commag. recording is the poor general quality, both of signal response and of stability. Also, the sound is recorded on 16 mm stock, 26 frames in advance of the related picture. This causes great difficulty when cutting the combined picture and film: the only solution is to re-record the sound from the stripe or the separate 16 mm magnetic film, which entails a further quality loss.

The sepmag. system obtains synchronization by recording direct on to 16 mm perforated magnetic film, as used in sound editing, on a special recorder, which is linked - either by the frequency of the current supply or by the Sel-syn system of interlocking motor drives - to the motor of the camera. This system is widely used in studio work, but is too bulky for general location work; moreover, the equipment is very expensive, and does not often feature in small unit 16 mm production.

RECORDING PROCEDURE

If there is no special work to be done, the sound man's equipment should be able to cope with all situations. The following list includes nearly everything which could be needed in documentary and feature film recordings:

Tape recorder:

with clean heads and loaded batteries or power cell
spare reel
mains power pack and pilot in case the batteries
        or the power cell get exhausted.
Depending on power supply and possibilities of connection,
        pre-amplifiers should be carried for the
        respective tape recorder.
Also battery adapter, antivibration pad and roll-off
        filter MZF 15 should be available.

Microphones:

1 or 2 dynamic microphones like Sennheiser MD 422 or Beyer M 88
1 or 2 condensator mikes like Sennheiser MKH 405 or 415
1 or 2 unidirectional microphones such as Sennheiser MKH 805 or MHK 815
respective windscreens for all microphones, if not included
several kinds of mounts for the mikes, such as tablestands, adjustable floorstands, rubber straps or other shock absorbers, pistol grip for shotgun types and chain for lavalier type mikes
boom and fish pole and stage clip

Cord and cables:

2 or 3 microphone extension cords
2 or 3 microphone connection cords
2 pilot cords
1 pilot extension cord

Basic tools:

such as spray to clean the recording head
solder equipment
spare plugs

Mixer:

if working with several microphones at the same time

Headphone; camera tape; sound report sheet.

Assuming that the necessary equipment is available and that it is of good standard, the quality of recording will depend on:

the acoustics of the recording area
the tape of microphone used
the placing of the microphone
the adjustment of the recorder

These considerations will vary according to the class of sound recorded, which is usually divided into speech, music and effects (FX).

Before the actual shooting the sound engineer should consider the sound aspects of the location, i.e. the acoustic. He should check if the room has much hall, i.e. give much echo, if there is extraneous noise and if there is wind.

If this is done before the actual shooting starts, it is possible either to alter the acoustics or, if necessary, to change location.

The degree of echo in a room is normally visible. Large, unbroken plain surfaces, many windows and bare walls with even surface indicate echo. Carpets, curtains, soft furnishings, many people in a room point towards little echo. A useful guide to the acoustics of a location is to record a hand-clap. It should die away fairly quickly, without sound muffled, and in no circumstances should it echo or ring.

If the acoustics are unfavourable, much can be changed before shooting. To render a clear, natural sound of speech, the recording room should be average living room size. The floor and the walls should be absorbent, since, reflection is the main reason for echo. If the location is too large, sound absorbing screens, panels of wood covered on one side with acoustic tiles are an effective means to make and let it sound smaller. If these are not available, blankets, coats or rugs hung around the speaker may make an excellent substitute. Even in a small room unwanted resonance from bare walls should be avoided. All bare surfaces should be covered with curtains or blankets, be it walls, windows or wardrobes.

In locations with high ceilings, reduction of echo can be achieved by placing cloth or fabric over polecats and reduce the vertical height. If there is a choice, the speaker or interview partners should be placed in front of surfaces which are echo absorbent by themselves, i.e. curtains or bookshelves.

Also the selection of the proper microphone and its position can help fight hall.

To trace extraneous noise, the most important thing is to listen properly to the "natural" background noise of a location. It is often difficult to estimate how well a recording corresponds to what is heard, because the brain has the ability to pick out what it wants to hear and what is important to listen to. It is possible for someone who listens to ignore a certain amount of background noise. The same does not apply for the microphone or the tape recorder. In this sense they are more objective. Therefore, to hear and perceive reverberations of extraneous noise, it is necessary to switch off the filter function of the brain, and to listen carefully. This is the only way to trace noise such as that of an air-conditioning, a refrigerator, flourescent lamps, or the sound of braking waves on a distant street. If this is not done the level of background noise will appear when mixing the tracks. Then it is particularly unpleasant, if the background noise of one shot differs in intensity from that of the next shot. It might be difficult to cover the different levels of atmospheric noise.

In closed rooms, much of the background noise may be avoided by closing the windows. In many cases, again the choice of the microphone and its placing helps. Background noise from electric sources is more difficult to fight. Electric current produces an electro-magnetic field. This magnetic field can produce impulses which acts on other electric lines through induction. Every part of the chain which is necessary to record sound can be influenced by magnetic fields of other electrical equipment.

If, when switching on the lamps a click or a deep humming sound is heard, it is likely that the microphone cables are too near to the light cables. The interference will be even more marked, when the cables are wound up like coils. In this case the separation of the cables will help. The same solution might help if the cables are near video cables, which is heard through rattle or cracking sounds. A general humming sound indicates, that microphone, recorder or cables are situated near a 50 Hz. induction field, for example near a transofrmer. A buzzing rattling sound indicates an induction field often caused by flourescent lamps. Here special care has to be taken when using a fish pole for the microphone. High currents like those necessary to run electrical equipment such as a welder, cause very loud rattling in recording instruments. The only possibility here is not to come near. If buzzing or rattling occurs when the camera is running, the camera motor might be defective. It might help to change the pilotcable. If radio transmissions can be heard with the headphone and sometimes different microphones pick up different stations, the microphone cables are not enough isolated or the preamplifier leaks.

With all reverberations caused by electrical current, the following precautions will help: to separate microphones, recorders and cables from potential induction sources; to use shorter cables for the microphones; to select a condenser microphone which is less susceptible to magnetic fields instead of a dynamic mike. To ground the whole sound system.

In general there will usually be less reverberation outdoors than indoors, but outdoors the background noise levels may be higher. Therefore, outdoors a windscreen, if it is not already an integral part of the microphone's design is a useful accessory for suppressing wooshing sounds caused by wind. Here also a test with different microphone types and filter adjustment helps to avoid too much disturbance from that source. A windscreen also helps against the popping that can be produced by consonants like "p", "h" or "k".

It should be pointed out here, that the goal of sound recording first of all is to record the important sound as clearly and cleanly as possible. Reverberation and all sorts of background noise can be added later in the studio if necessary.

After the technical procedure is clear, the next step, before shooting starts, is to think about what is the situation to be recorded.

Who says what, how, where?

How does the respective picture, the sound is used for look like?

Who speaks, one person or several players? Are they amateurs or are they actors? Do they whisper, speak or shout? and in what direction? Do they move while speaking or remain stationary? How was the scene just preceding this shot and what will come after the shot to be taken right now? How are they connected?

The image that should go with the sound determines the perspective of the sound and so the microphone positioning. The sound must coincide with the distance of the viewers to the person depicted and must be appropriate to the location shown.

All these consideration give already a hint what microphone to choose and where to place it. The final decision can not be taken before positioning of the camera and image area are decided.

One more point has to be taken into consideration. As has already been said in the part on extraneous noise and how to fight this, the positioning of the lights and the resulting disturbances through electric field of equipment and cables might influence the type of microphone used and its placing.

Selection of Microphones

The choice of microphones is dependent on three criteria: the quality of the sound to be recorded, which is commonly divided into speech, music, and effects; the acoustics of the location and the placing of all other shooting equipment and players.

The most commonly used microphone for speech recording is the ribbon microphone, though this has a drawback in that, if it is placed too close to the mouth of the speaker the bass content of the voice is overemphasized; specially compensated ribbon microphones are, however, available for speech recording.

Moving-coil microphones are also widely used for recording speech. These are generally satisfactory, but can emphasize sibilance (the ss and sh sounds in speech) if used too closely.

Shotgun microphones are often used in cinema verite type filming, because they function within a relatively narrow pick-up pattern and can register speech from a wide area. Sometimes the acoustics of a location, and echo can theoretically prevent the use of a microphone, best equipped for the purpose. As has already been mentioned, it might be better on certain occasions, to use a dynamic mike, which is more "shortsighted" and less susceptible than a condensor mike.

Positioning and number of speakers as well as the image area determine the choice of the microphone too.

Is the distance to the mike relatively small (close-ups and all close-shots) the important variable is the direction out of which the sound comes. This has to be looked at from the point of "view" of the microphone. A cardioid mike will normally cover one speaker, even if it moves but also a discussing group of people. A directional mike has to be pointed to the person speaking and has to follow its movements precisely otherwise the sound will be recorded at different levels or not at all.

If the distance to the microphone is big (full shot) a condensor microphone will give good results, but also the "tele" effect of a shotgun can be used.

The placing of the microphone normally is the compromise between its ideal placement for recording and its invisibility even with wild camera movement.

The usual guiding principle for indoor recording from the point of view of acoustics is, that the closer the microphone to the sound source, the lower the level of reflected sound. The more reverberation or reflected sound is needed, the further away the microphone should be. For normal voice recordings, good results are achieved if the mike is placed between six inches to two feet from the mouth, depending on the kind of microphone.

Some microphones have a kind of tone control to be used when recording voice at close distances. If microphones are used which have no adjustment, there is some danger of producing a sibilant recording. Therefore tests at varying distances are useful. The microphone should be placed at the same level as the lips, but naturally, if the microphone is visible in the shot, as in documentaries or newsreel, it should not cover or conceal the face or mouth of the speaker.

Microphones should be mounted indirectly, suspended in their supports by rubber straps or other shock absorbing material. This is necessary because otherwise vibrations can be transferred. Also scraping of chairs and rustling of clothes are not as easily transmitted if a shock absorber is placed between microphone and its mounting. It is also useful to subdue breathing noises and shaking from hand movements.

The main types of support are the stand, either a table stand or a floor stand, which will be adjustable and should have a heavy base.

The table stand is often the most effective way of registering the sound. In documentaries and newsreel it is a convenient and time saving method to record and its appearance on screen is accepted. In feature films, it can be concealed behind lamps, flower pots or telephones. Its disadvantage is, that the speaker must not leave its place, because it has to be pointed accurately. If possible, the surface on which the microphone is placed should be covered with absorbent material, so that there are no unwanted reflections from this direction. It also gives better results if the speaker does not come into contact with the table or other device on which the mike is placed.

A floor stand is based on a boom. The main essential of a boom is that it is adjustable in length, angle of tilt and rotation of the microphone. A simple home-made boom might be a broom handle with the microphone tied on one end, while a typical professional boom will have functions controlled by wires, pulleys and handles and may even be motorized.

A floor stand is used when the speaker is standing and for stage performances. If the speakers are experienced, normally no difficulties will occur. But people not acquainted with public appearance tend to move more or less wildly and not to speak into the microphone. Therefore on these occasions the microphone should be appropriate for this purpose and should be directed respectively.

The floor stand is indispensable with most music recording to separate the different musical instruments. The floor stand can be also used for a speaker who is sitting, especially if it should not appear in the picture. In this case it should be extended to half length so that the microphone is placed at the height of the knees.

There are several types of hanging suspension. This kind of mount is indispensable for feature films. The microphone hanging and moved above the players, can follow their movements, allows positioning and direction towards the source of the sound and does not pick up reflections from high ceilings. In principle the fish pole is a stick whose length can be adjusted and whose rotation can be regulated. A microphone joined to it can make a roll of 360° but normally only 180° is used, since above it there is only the ceiling. So the microphone can follow the speakers and can be directed towards the sound source, i.e. the mouth of the speaking persons. A fish pole can be only as well placed, as the person who operates it is able to do.

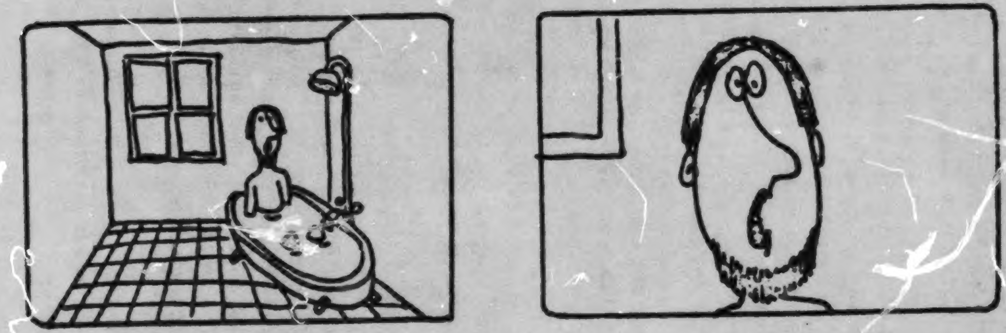
The microphone should always placed facing the mouth, therefore it should not be positioned above the speaker, but right before. If there are several speakers in one scene, the fish pole needs not only be panned but also and at the same time extended or shortened. All movements should be rehearsed. It is also important to see that the fish pole does not cast shadows, that it does not appear in the picture and that the person who operates it can move freely, especially when moving backwards. It is less likely that the instrument will be depicted on screen if the fish pole is held vertical to the upper edge of the picture frame. The fish pole should be operated without extraneous noise, i.e. steps or audible hand movement of the person operating it. It is also necessary that the person who operates it knows the text, the area of the shot, the movement in the shot and watches the camera, not only to see that it does not come into the picture, but also because the image area determines the sound perspective.

If the players do not move, a microphone could be used, which hang without mounting ties from the ceiling. A cardioid mike hanging straight down, can cover up to ten persons. But it is useful in most cases, to let it hang slightly angled.

To record stage performances, the stage must be covered by hanging microphones. The number of mikes and their placing must be tried before shooting, because if they are not sufficient or are ill-placed, sound vacuum can occur and the level of the recordings of different microphones might fluctuate. Normally 5 microphones will give sufficient coverage for a normal stage. It might give better results if the hanging microphone is supported by one of the shotgun type.

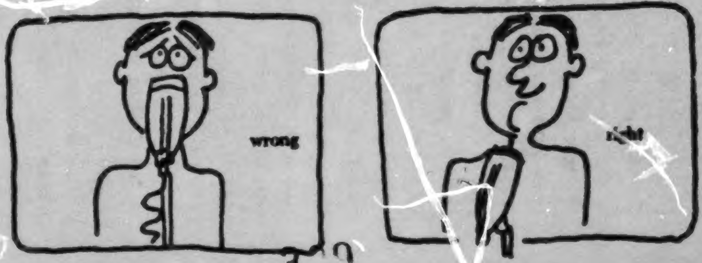
An ultradirectional microphone should not be held in the hand, because the contact between hand and mike will lead to disturbances. A pistol grip or a resilent mount will give better results in this cases, especially if the mike should be moved.

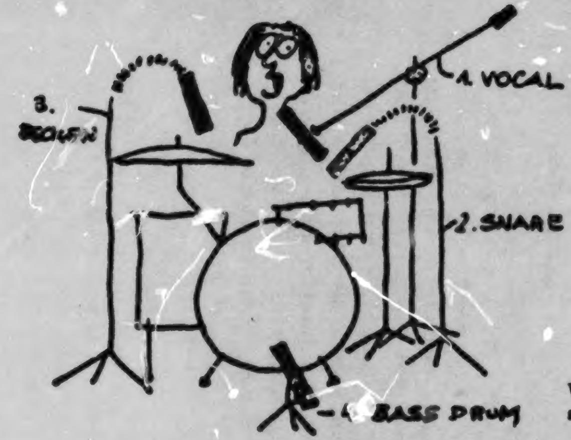
POSITION OF MICROPHONES



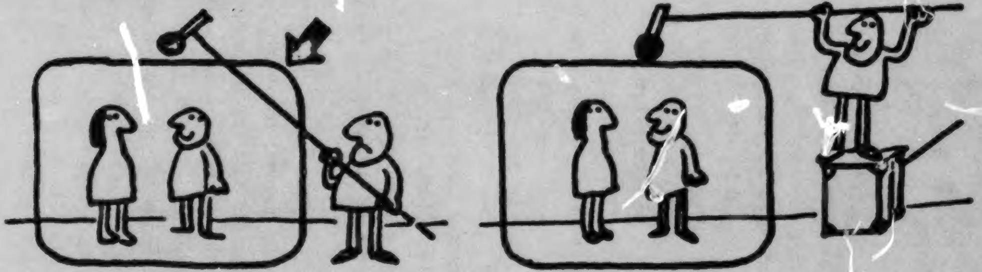
The respective picture determines the sound perspective. Since some degree of colouring from the acoustics of the location is necessary, the sound of picture 1 should contain more echo than that of picture 2.

The microphone must not hide the face of the speaker





When recording music a microphone stand is indispensable. The picture shows excessive use of microphone stands.



It is less likely that the boom will come into the picture if it is held horizontal to the picture frame. If necessary a base to elevate the one holding the microphone is useful.

RECORDING

When the microphones are chosen and positioned, and the acoustics of the location are adapted the next important step is the adjustment of the tape recorder. The running speed of the recorder has to be chosen according to the sound which should be recorded. Then the recording level should be set. The most widely used method to set the level or volume control is the record level indicator. This will be either one of the magnetic eye type in cheaper instruments, in which two illuminated areas move towards the center of the scale from either end according to the intensity of the signal, or it will be set by a VU meter, a galvanometer that monitors the loudness of the recorded sound. In the last case a maximum level of signal desirable will be marked on the scale and the pointer or needle should not reach above the marked danger zone. If the signal is allowed to exceed the level indicated on the meter, distortion in the recording will occur. In the first case, the two illuminated strips of the magnetic eye should just touch in the center of the indicator. If the level of recording is set too low, hiss will result, if it is too high the sound becomes muddy and distorted.

Some recorders - e.g. the Nagra III - have an automatic signal-level setting, and will compensate for any level of sound fed into the microphone. This facility can be very useful, especially with hand-held sync shooting, or in situations where there is no time to check signal level between each take. There is, however, a slight fall-off in response if this device is used, and in some situations the automatic compensation can have unusual effects. For example, in a situation where a voice is talking over drumbeats, the automatic facility will compensate to keep the over-all signal level constant, so that for the duration of each drumbeat the level of the voice will be depressed, creating a noticeable fluctuation in the voice.

Adjusting the volume properly needs experience and instinct. In a certain way the setting of the sound level on the recorder can be compared to pulling the f-stop on the camera. To record at a too high level is similar to overexposure and distorts as much whereas recording at too low a level results in hiss with the effect, that through the noise inherent in the sound system the important information gets lost, as pictorial information is no longer visible in underexposed images.

In general one can say that the best recordings are made just on the edge of overload. All sound should be recorded as loud as possible. This is so, because only then, the distance to the hissing inherent in the system is as large as possible and so the dynamic range will be greatest. If a low sound is recorded at a low level the verge which separates it from the hiss is small and will remain the same, no matter how loud it will be transferred to another tape. If the low sound was recorded as high as possible, its distance to the system noise will be large. If later when transferring the recording, the sound level is lowered, also the hiss noise will be lowered and since the distance between both is large, the hiss might nearly disappear.

In the practical work it is often not possible, to adjust every sound to its best level and to record everything at its highest possible level. In a quick exchange of dialogue where the sound level is apt to fluctuate very much it is not possible to record every word at its highest level, not only because turning the switch can not be done so quickly but also because the background noise would change with each adjustment. Here it is necessary adjust only slightly and very carefully. Very low sounds, like atmospheric and background noise, can not be recorded on a high level because the hissing of the microphone itself might be too high. If in such cases the control would be set on full even more hissing would be produced and recorded.

It should be checked if the amount of tape is enough for the coming shot, if the batteries are loaded, if the sound heads are in good shape. A test with the players should also be made, to adjust the recorder to the sound level. Here it is important to note, that even professional actors tend to speak louder and with more dynamic in the real shot, than they do in a rehearsal. Therefore it is useful to bear in mind the sound level used at the actual shooting, so that for the next shot adjustments have to be made only according to the new microphone position and the general mood of the scene.

This test is also the last possibility to look out for shadows cast by microphone or fish pole. If the microphone has to be moved during the shot, it is useful to operate it with the light and to avoid that it comes too near to the decorations.

TYPES OF SOUND

Technically, for the filmmaker, recorded sound falls into two categories: wild sound and synch. sound.

Wild sound or wild track denotes all sound not recorded in synchronization with the picture at the time of filming. This does not mean that the sound has to be out of synch with the picture forever: it can be synched to the image, and will be in most cases, at the time of editing. Wild sound also does not mean, that this sound is not recorded at the time of filming. In many cases it will be recorded either while actual shooting takes place or right afterwards at the location of the shot. The term wild track or floating track is used for all sound which is recorded not in synch with the camera action during shooting. With regard to the contents, wild sound includes music, effects, background noise, atmospheric noise and commentary.

Music

The technique of recording music is very elaborate. Music recording need not be wild, it can be synch, especially in films on musical topics or in many cases where the music source is shown in the picture. But in most cases with background music and musical accompaniment, the recording is done as wild track. If the music used is not choosen from a library or archive, i.e. is not pre-fabricated but is done for the specific film, the most important point while recording is to bear in mind that musical instruments differ radically in their acoustic characteristics. As general guidelines, the following points should be borne in mind, though experiments and tests are still the best criteria for recording music.

A ribbon microphone, with its particular sensitivity is usually very suitable for music recording; and assuming that the acoustics of the recording location are reasonably good (or have been suitably adapted), it is better to use one microphone at a distance than to have two or more placed close up. Close placing of several microphones will lead to problems in re-constituting a balanced sound in the actual recording.

Stringed instruments, especially in their higher frequency range, tend to produce very directional sound, radiating in a narrow angle perpendicularly out from the sound board. By placing the microphone away from the direct perpendicular path of the high frequencies, it may be possible to accentuate the lower frequencies (bass) of the sound.

Wind instruments are not so critical: microphone placings above or in front of the player will often be found to produce good results. Again, experiment will indicate the best placing. With all instruments beware of unwanted mechanical sounds, which can easily be picked up if the microphone is placed too close: the operation of keys and valves on wind instruments, or the scraping of bows and fingers on strings, can easily figure on the music recording if care is not taken.

Recording a piano depends very much on the acoustic nature of the location, and the type of piano. With a grand piano, a good place to start tests is perpendicularly out from the sound-board. Moving the microphone to the tail of the piano will tend to reduce the bass content of the sound, while moving it towards the keyboard will increase bass. With an upright piano, start directly behind the piano, or, if the lid is open, near the pianist's right shoulder. As with all music recording, make as many trial recordings as possible, and listen to the sound of each carefully. With music recording, each situation and each instrument is a different proposition.

Effects, Background and Atmospheric Noise

Sound effects are of two broad types: background or atmospheric effects, and spot effects, which relate to a particular on-screen action. Generally there will be no basic difference in recording for two types of effect, except that spot effects will have to be more closely tied to the length of action on screen: for instance if a background sea effect is needed, the recordist can shoot an ample footage of the effect, and the editor will then it to length on the bench. If, however, a spot effect of a referee blowing a whistle is required, for the best effect the whistle recorded should be the length required by the picture. Theoretically, a section of a longer whistle could be used, but this may well lose the characteristic sharpness and pattern of the sound required.

Spot effects, particularly, should be carefully studied before recording, to establish the best way to shoot the effect. Different microphone positions can be tried, and the best used; and in doubtful cases (since it is usually impossible to see the film while recording the effect), several different versions should be taken. With spot effects, it is important to get the microphone close to the sound source, eliminating as much ambient noise as possible. A microphone is non-selective, in contrast to the ear and the brain, and a recorded sound can be very different from a natural sound. In some cases it may be found that even after every possible alternative has been tried, the recorded sound is not even approximately right when put to the relevant picture; or that however close the microphone has been placed to the sound source, there is still an unacceptable amount of extraneous noise on the recording. In such cases, the effect will have to be faked, and the ingenuity of the sound recordist is called into play.

Almost all effects can be faked somehow, and it is surprising how often the fake turns out to sound more lifelike than the actual recording. One further point about the recording of spot effects: sound effects, like picture takes, can be broadly divided into long shots, medium-shots and close-ups. Care should be taken that if the picture is close-up, the sound effect should be recorded in close-up too, and vice versa. However, there is a certain latitude in this rule, since certain conventions about the audibility of dialogue and effects have grown up with the cinema: two cowpokes riding the trail in MLS can quite legitimately be heard conversing over distances from which, in 'real' terms, even healthy yells would be faint. Here again, it is a question of assessing the needs of the particular scene.

Recording background effects is normally quite straightforward: decide how obstrusive or unobstrusive the background effects need to be, and record them in a suitable manner. Sharp, identifiable sounds in the background will draw attention to it, and should be avoided for ordinary general effects. This point must be specially borne in mind when recording for loops.

Finally, with regard to effects recording, the question of 'fill' takes should be noted. 'Fill', 'shush' or 'buzz' is the barely audible background noise that is used to fill in parts of the sound-track where no other sound is being used. Cutting out all recorded sound, and filling in the track with spare picture film, results in very noticeable 'drop-out' on the final sound-track. Unmodulated magnetic film can be used to fill in gaps, but it is better to have specially recorded 'shush', which can vary slightly according to the scene: It can be recorded - with the record level turned right down, exterior or interior, and in a number of different situations.

Commentary

There are two ways to record commentary. It can be recorded wild, in the sense that the speaker reads the commentary script without attempting to relate it to the picture, though the speed of reading might be estimated beforehand, or it can be recorded cued to the picture, i.e. the speaker sees the picture while doing the commentary and sees that the reading pace coincides with the respective images.

In the first case the recorded commentary is fitted to the completed picture on the editing bench and the pauses are filled out with filling track. The main disadvantage of this method is that the commentary might not fit too well to the images and that certain passages might be too long in relation to the available or usable image length and have to be re-recorded later. But this method has the advantage, that mistakes made during recording it can be edited out and the reader simply stops after the mistake, waits for two seconds and starts anew. Furthermore no sound proof room has to be provided (sound proof because in the second method the film has to be shown and the room where the commentary is reading must not pick up the sound of the running projector). Therefore, if the commentary is not too long, this method will work quite well.

The second method is to record the commentary to fit the picture. The commentator should be seated in a sound proof room, from which he can see the picture being projected. He must then be cued in some way, so that he starts particular sections of the commentary in the correct places: pause marks will be indicated in the written script, and the commentator will restart on the next given cue.

The usual methods of cueing are by footage or by marks on the film. For cueing by footage, the commentary must be timed, and the length of each section of commentary known. The commentary is then cued so that sections start at specific footages in the film, and the commentator starts each section of commentary when the appropriate footage is displayed on the footage counter - which, incidentially, should be large and clearly visible in reduced light. It is best for the commentator to be cued by a third person, rather than to have to watch out for the footage numbers himself: a tap on the shoulder, or a flashing light may serve to indicate the start of each section. This is especially true of the other main methods of cueing, from marks on the film itself. Cue-marks which appear on the film itself should be made over several frames, in order to give the commentator time to react to them, and subsequently to start in a natural and unhurried style.

With commentary and all studio recordings, care must be taken to avoid extraneous noise during takes. Chairs must not be scraped, clothes should not rustle,and the cueing assistant must not cough or breath too heavily. The commentator must be careful of his script sheets: they should be seperate not pinned together, and clearly typed, on one side only, and in double spacing. If the corners of the sheets are turned up, they may be easier to move quietly to one side when finished. If sheets are angled up from the table top, the commentator will not have to drop his head as he reaches the bottom of a page, and will consequently keep a better view of the picture.

Unless very sophisticated recording equipment is used, mistakes made when recording to picture cannot be rectified by merely running back to the beginning of the section, or synchronization between picture and commentary will be lost. If a mistake is made it is best to carry on as normal, and re-record the fluffed sentence at the end of the tape. All such retakes must be separately announced on the tape, and great care must be taken to ensure that timing, acoustics and recording levels are exactly the same as the main part of the tape, or the retakes will be instantly noticeable when cut into the sound-track. The retake is cut into the main track on the bench during track-laying.

Big recording studios and specially equipped sound labs (which frequently offer commentary recording as one of their standard services) usually have recording equipment of the 'roll-back' or 'rock and roll' type, where recording medium and picture are locked in sync, and both can be run back to any necessary point and sections recorded again where mistakes have been made.

RECORDING WITH SYNCH SOUND

Most of the information supplied so far can be used also for preparing synch sound tracks. But there is one additional point peculiar to synch sound, this is that picture and sound have to coincide while filming. Out of this necessity several factors result.

Camera Noise

When recording synch most cameras have to silenced in some way so that their running noise is not recorded with the sound. The farther away the camera is placed from the microphone, the lower its mechanism noise will be recorded. This is especially true outdoors and indoors in acoustically dead rooms. In rooms with normal or excessive amounts of reverberation, it will not help too much to move the camera away from the microphone. A test run under normal shooting conditions is useful because most cameras make more when they are run with film, than without. Sound barneys are available for many 16 mm camera designs. A barney is a padded housing covering the camera to reduce the noise of its mechanism. In principle towels or blankets to cover the camera would work in the same way. The lens and the viewfinder eyepiece remain uncovered by the barney.

To reduce the sound of the camera a blimp can be used. A blimp is a rigid structure housing the camera which provides very good sound reduction. It is possible to use a microphone within three to four feet of a camera. Blimps tend to be heavy and clumpsy. The lens of the camera looks out of the blimp from behind an anti-reflection coated optical quality glass. Some blimps are less heavy and bulky because they are made out of fibreglass. Blimps are also available with battery powered heating elements for use in adverse weather.

Audio Perspective

Since the sound recorded in synch is normally used for the final film, the sound which is heard must fit to the image not only in the sense that the sound coincides, but also that it gives the same "view" on the depicted object as does the picture frame. Since sound is related to space, things which are near sound different from things which are far away. This fact has to be borne in mind not only when selecting the microphone position but also when choosing the type of microphone. In general, the most useful microphone for sync sound is the unidirectional or cardioid mike. This type of microphone does not record sound behind it but encompasses more or less the hemisphere in front of it. So it does not pick up the noise of the camera mechanism nor out-of-shot sounds, though it is sensitive to reverberated or reflected sound from all sources as long as they are in its direction. If the room is very lively and reflection is high an ultradirectional or shotgun mike would be useful to reduce reverberation and unwanted noises, since these microphones cover an even smaller 'angle of view'. Sound technicians in big studios claim that they can create the proper audio perspective to any clear undistorted sound. So if a film has to cut from a close-up to a long shot, the proper level of reverberation would be added to the respective shot to match the visual portion of the film. In the close-up the sound would be clear and crisp and would lack the reverberation added to the long shot. Under most circumstances this refined form of mixing is not possible and the microphone has to be positioned in that place where the recording of sound will match with the image.

RECORDING TECHNIQUE

For years the medium of original recording was optical sound on motion picture film. Although this method is still used for prints, the optical track for original recording has all but disappeared. Magnetic sound recording is now universally used for original recording and dubbing. But there are still different systems.

Single System Sound

When the sound track - optical or magnetic - is recorded on the same piece of film at the same time as the image, we have single system sound. Most of the single system sound done by television news crews uses magnetic prestriped film.

Because of its better quality sound, single system magnetic sound has more or less superseded optical recording. The Auricon 16 mm camera models are the only presently manufactured machines that can record optical sound on film.

After the film passes through the camera gate, where it is exposed, its intermittent motion must be smoothed out before it can pass over the magnetic (or optical) recording head. A loop of film passes by rollers, one of which is attached to a fly-wheel, changing this stop-and-go motion to the continuous motion that sound recording demands. (This is the way sound projectors work.) The camera then acts just like a tape recorder by adding the sound signal to the iron oxide coating on the film.

The distance between the gate or aperture and head has a standard displacement, so films can be played back and screened on a standard sound projector after processing.

One of the chief disadvantages of the single system recording scheme is its difficulty in editing. For 16 mm, for example, sound is twenty-eight frames in front of its corresponding image. What to do? One possibility is to re-record the sound on 16 mm magnetic film, and then cut the picture and track. Another solution is to re-record the track so that it is adjacent to the picture instead of ahead of it. Magnasync/Moviola and Amega offer what is called a displacement recorder which lifts the track from its fore position and places it opposite the image so that the film can be edited for sound and image simultaneously. Once the editing job is accomplished, the film may be put back into the displacement recorder, and the sound is re-recorded back into the projection sync position.

Sync Pulse-Double System Sound

Double system sound makes use of a camera and usually a quarter inch tape recorder. The cameras used often have DC motors which can be battery powered; the motor may be set for the precise running speed by a tachometer, built into some cameras, while other cameras offer the option of using a precisely running constant speed motor; in the United States, that speed is 24 fps; in Europe, for television films, the speed is 25 fps.

Double system cameras use what is called a sync pulse generator - either built in or as an accessory. This device is an AC dynamo designed to generate a 60-cycle current for every twenty-four frames of exposed film. (For European TV a 50-cycle current is employed.) In the time interval that one frame is exposed, two and a half pulses are generated by the sync pulse unit. The camera is connected to the tape recorder by a cable, and this 60-cycle signal is recorded and used as a reference tone for translation of the tape to magnetic film

The camera does not control the speed of the recorder: it tells the recorder how fast it is going at any given moment: the sync pulse generator simply tells the recorder the rate at which it is running for each exposed frame. If this information is stored on the tape, it is possible to come up with magnetic film having a sound recording with one-to-one relationship with the film.

The sync signal, recorded on the tape with any one of a few methods, must be present but inaudible. The simplest method uses a dual track or stereo tape recorder: half of the tape width is used for the sound, and the other half for the sync signal. Another method, by Perfectone, rarely used these days, records a signal along the top and bottom edges of the tape. This push-pull method of recording requires dual heads to combine the signal into a usable form. The third method, which is the most widely used, is known under the names Pilote, Pilotone or Neo-Pilotone. This uses the full quarter inch track width, but the sync head gap is oriented at right angles to the sound record and playback head gaps.The sync signal is recorded in a narrow track right down the middle of the audio track. A signal recorded on the tape with this method would not interfere with the sound recording.

The most frequently seen machines used for double system recording are the Tandberg II-P, Uher 1000/N, Stellavox, Arrivox-Tandberg, and Nagra models. All can run by rechargeable in-cad cells. The tape speed most often chosen is 7½ ips, although 3 3/4 is used as well. Stereo machines may be used, without modification, to record the audio and sync signals on separate channels.

Wireless Sync Systems

There is a way to eliminate the cable connecting the camera and recorder for the sync pulse signal. The solution is elegant, expensive and, for some applications, very useful. The system involves a crystal oscillator controlling the camera motor. In some cases small lightweight AC synchronous motors are used. The most interesting characteristic of this kind of a motor, from out point of view, is that its speed is frequency dependent. That is, the rate at which the motor rotates is determined by the frequency of the current it receives. There are crystal oscillators that can control the current frequency received by the motor to an accuracy of one part per hundred thousand - adequate for all sync applications. A similar crystal oscillator is used at the recorder for generating the 60-cycle sync pulse. This system could also be used to control the speed of several cameras (and recorders if you like) so that they all run in sync. Such a system is available for the Beaulieu News 16, Eclair NPR and ACL, Arriflex and other brands as well.

Another method of wireless sync uses a radio transmitter at the camera to broadcast the sync pulse signal to the tape recorder.

Double System with Mag Film

Instead of a tape recorder, you can use a magnetic film recorder for the original recording. If the mag film recorder uses the sync pulse to control its speed, you can get synched picture and mag film without resolving from quarter inch tape.

Normally when shooting synch points on both film and tape should be made to make editing easier. Traditionally this is done by using a clap board or a slate, which consists of a wooden clapper attached to a slate framed in wood. The information relevant to the shot taken is written on the slate with chalk. The clapper board should be held in front of the camera in a position where it can be read clearly through the viewfinder. The tape recorder is started and when it is running to speed, the sound recordist should call 'running'. The camera should be also started and after a second or two when the motor is on speed, the clapper is sounded. The clapper board operator should read out clearly the slate and take number written on the board. The clapper board then whould be withdrawn. When it is well clear of the frame, there should be a further pause before the call 'action' is given. At the end of the take, a second or two should be allowed before switching off the camera motor.

Some cameras as the Eclair or the Arriflex offer electronic blooping. After the camera and the recorder are turned on, a button on the camera is pressed and a blup situated inside the camera either fogs the edge or flashes several frames of the film. At the same instant, a tone normally 1000 Hertz is recorded on the tape. Some cameras do the blooping automatically and no button need to be pressed. During editing the film jarked by the flashing bulb and the reference tone are put into synch. The automatic marking system has the further advantage that it can be operated by two people, whereas the clapper board system need three.

All the time that shooting continues, the camera operator, or his assistant, should keep a camera report sheet in which he notes full technical details of every take. Specially prepared report forms can be obtained from labs and general film suppliers, and these should always be used. They should record details such as slate and take number, action, filmstock, location, interior/exterior, day/night, sync/mute, camera speed, aperture, camera number, and any other relevant information. Which takes are worth printing, and which are not, may also be listed, especially on large-scale productions where many takes of each slate are shot. The sound recordist should also keep a sound report on similar lines, with details of all takes, plus general information about type of recorder, tape speed, sync system or wild, full or half track, date, production, etc.

EDITING

Film editing may be compared with cutting, polishing and mounting a diamond. A diamond in the rough state is barely recognizable. The raw diamound must be cut, polished and mounted so that its inherent beauty can be fully appreciated. In the same way, a film story is a jumble of odd shots until, like the diamond, it is cut, polished and mounted. Both diamond and film are enhanced by what is *removed*! What remains tells the story. The many facets of the diamond or the movie, are not apparent until the final cut.

What is left must be woven into a continuous narrative; to present the screen story in a manner that captures audience interest and holds attention from opening scene to final fade-out.

Only good editing can bring life to a motion picture! The various shots are just so many odd pieces of film until they are skillfully assembled to tell a coherent story. Cutting takes up the slack in the film, by removing all superfluous footage: false starts, overlaps, unnecessary entrances and exits, extra scenes, duplicated action, bad takes.

When a director sets out to film a story, he is normally not concerned with showing it as an exact record of one person's experience. Instead, he *interprets events*, shows them in the way he considers dramatically most appropriate. When making a dialogue scene, to take the example already mentioned, he does not attempt to show it through the eyes of one of the characters on the screen: that would mean keeping the camera still, showing all the time only the close shot of the opposite actor. Nor does he try to show it through the eyes of an impartial observer physically present at the scene: that would mean that he could only cut to shots which were all taken from a fixed camera position. Instead, the director's aim is to give an *ideal* picture of the scene, in each case placing his camera in such a position that it records most effectively the particular piece of action or detail which is dramatically significant.

He becomes, as it were, a ubiquitous observer, giving the audience at each moment of the action the best possible viewpoint. He selects the images which he considers most telling, irrespective of the fact that no single individual could view a scene in this way in real life.

In doing this, the director does not more than exercise his elementary right as an artist: namely, to select from a given situation particular aspects which he considers significant and to present them in the manner he feels to be most useful to his purpose. Thus if we can find no parallel in actual experience for certain editing devices, it is simply because the editor and director do not want to reproduce the physical world as one normally sees it. A spectator, moreover, does not expect to see a film unfold like an episode of real life - any more than he expects a novel to read like a diary. He accepts the film-maker's right to select and emphasize, to show a piece of action in a way which is obviously more suitable to dramatic presentation than is our normal perception.

This is as far as a theoretical justification of editing can take us. In so far as the editor changes images abruptly, he is reproducing the normal mental mechanism by which we alter our attention from object to object in real life. This justifies the mechanical process of cutting. In so far as he accomplishes particular changes of view which are not comparable to outside experience, he exercises the right of selection which we accept from an artist.

CONSTRUCTING A LUCID CONTINUITY: SMOOTHNESS

Before the final continuity of a sequence is arrived at, the editor normally takes his material through two distinct stages. First, he assembles a rough cut in which the order of shots makes film sense and the transitions are mechanically smooth. Second, he approaches the material again to refine the continuity of the rough cut in such a way that it becomes dramatically as well as physically appropriate. Some writers have divided these two functions, calling the first cutting and the second editing but the terms are, in common usage, applied interchangeably so that the distinction is likely to confuse rather than to clarify the issue.

Nevertheless, we will find it convenient to consider the two phases of the work separately because they present somewhat different problems.

The main purpose of assembling a rough cut is to work out a continuity which will be understandable and smooth. Making a smooth cut means joining two shots in such a way that the transition does not create a noticeable jerk and the spectator's illusion of seeing a continuous piece of action is not interrupted. If, to take an absurdly simple example, we cut from a long shot of an actor standing by a mantlepiece straight to a medium shot of the same actor reclining in an armchair, the transition will obviously be unacceptable: a spectator seeing it will immediately become aware that he is not viewing a continuous piece of action and the illusion will be broken.

This simple instance shows that the process of smooth cutting is subject to certain mechanical principles. These we shall attempt to state below. But as will be seen later, all the "rules" of smooth cutting are subject to the much wider discipline of the dramatic, as opposed to the mechanical demands of the continuity, so that they are not to be taken as binding or universally valid.

MATCHING CONSECUTIVE ACTIONS

The most elementary requirement of a smooth continuity is that the actions of two consecutive shots of a single scene should match. While the film is still on the floor, the director - aided by the continuity girl - sees to it that if a scene is shot from more than one angle, the background and positions of the players remain the same in each take. Clearly, if a long shot of a room showed a fire burning in a hearth, and the following mid-shot revealed the grate empty, then a cut from the one to the other would create a false impression. Keeping the set background constant throughout a series of shots is, however, a comparatively simple matter.

A more difficult aspect of the same problem is to keep the action and movement shown in consecutive shots accurately continuous.

If an actor starts a movement - say he is half way through opening a door - in one shot, then that movement must be continued in the next from the precise moment it was left. If the editor cuts the two strips of film together in such a way that a part of the action is duplicated in the two shots the effect will appear unnatural. Equally, if he skips a piece of action - say he cuts from the shot where the door is half open to another where it is already closed - there will be a noticeable jump in the continuity and the cut will not be smooth.

The matching of actions in two consecutive shots is a comparatively simple matter for the experienced editor, and even for the novice it is only a question of experimenting until a satisfactory cutting point is reached. More difficult, and also more open to opinion, is the problem of where in the course of a particular piece of movement that cut should be made.

Take an example. A man is sitting at a table on which stands a glass of wine. He leans forward, picks up the glass with his right hand, brings it to his lips and drinks. Let us assume that this simple scene has been covered from three different angles and consider the various ways in which the editor could cut from one to another.

If the intention is to cut from long to medium shot, the editor could do one of two things. He could let the action start in long shot, and then at some point during the downward (or upward) movement of the man's arm cut to the matching medium shot. Alternatively, he could wait for the point when the hand grasps the glass, and time the cut in such a way that the whole of the upward movement appears in the second shot. Without being dogmatic about the point, we can say that it is normally preferable to use the second method. By showing one specific movement in long shot and the other in medium shot, the cut does not interrupt a continuous flowing movement, but is, so to speak, punctuating the whole action at the moment of rest. The impression created is that two distinct phases of the movement are seen in two distinct ways: the flow of movement is not interrupted until it has of its own accord momentarily come to a stop.

An alternative moment of rest occurs when the actor is just about to start his movement, and this provides a third and possibly the best cutting point. Just before the actor starts his forward movement, his facial expression - a glance downward, possibly - will register his intention. If the cut is made precisely at this point, i.e. just before the hand begins to move - it will be smooth, because it will coincide with the moment of change from rest to activity. Before the cut, the actor will be sitting still: then, as he registers his intention of moving his hand, the spectator will anticipate what is about to happen and will be ready to see the effect of the resolution in another shot.

This last timing of the cut is particularly apt in the case where the transition is to be from close-up to medium shot. At the moment the actor begins his forward movement, the spectator will want to see the effect and will therefore welcome the cut from close to medium shot. The cut will, in fact, merely be altering the size of the image in such a way that the entire action of picking up the glass (which the close-up cannot show) becomes visible.

If the reverse is required, that is to say if a cut from medium to close-up is needed, then there is again a good case for cutting during a movement. Most of the action could be shown in the medium shot and the cut to the close-up delayed until the point in the man's upward movement at which the hand is just entering frame. In such a case, the editor must, of course, match the action of the two shots. The cut will be effective because it will, so to speak, be cueing the hand into the close-up. There is a pictorial reason for the cut because it comes at the precise moment at which the close-up begins to contain all the significant action.

Thus it appears that a cut which is necessary to accommodate a piece of action not visible in the previous set-up, is usually preferable to a cut which fortuitously interrupts a continuous movement. But it must be emphatically stressed that this is not always so. We are here only concerned with describing the various mechanical possibilities without, for the moment, considering which is dramatically most apt.

EXTENT OF CHANGE IN IMAGE SIZE AND ANGLE

Figure 2 shows a possible progression from a full shot to two alternative closer shots. It will be seen that the difference in size between a and b is very small, and that the pictorial composition of the two shots is almost the same. As a result a cut from a to b will be unsatisfactory. The spectator will witness only a very slight change in the image, and will be momentarily irritated by what will appear to him as a small but clearly perceptible shift. There will be insufficient contrast between the succeeding images to make the transition smooth. A cut from a to c, on the other hand, makes a quite distinct contrast: the composition of the two pictures is entirely different and there is no longer any question of a small shift in cutting from one to the other. The cut will therefore be smooth.

A similar example is provided by Figure 3. Here again, the cut from a to b brings about too small a change in image size to make it mechanically satisfactory; if a cut to a closer shot is desired, then it must be to a considerably closer image, such as is illustrated in c.

Apart from this mechanical reason, there is another consideration which in both cases makes the cut from a to b unacceptable. Every cut - this much we can insist on - should make a point. There must be a reason for transferring the spectator's attention from one image to another. In the case of cutting from a to b the change is so small that the dramatic point the editor is trying to make is, apparently, not really worth making. No appreciable dramatic purpose can be served by cutting from a full shot (figure 2a) to a slightly closer image which is cut off at ankle level (figure 2b). The spectator will sense that nothing significant is being said by the cut and will therefore not accept it without irritation.

Here are some more examples:

> Mother, father and daughter are having tea together. Dialogue between the parents.

The daughter interrupts and asks her father to play chess with her. The father says that he has a headache and that he is too tired anyway. The daughter is disappointed; the dialogue between the parents continues.

The events in this scene are plain, but the question is how to cut the sequence.

Wrong:

The whole sequence is done as a long shot with the exception of one close-up of the disappointed face of the daughter. This results from bad script-writing. The needs of editing have not been considered in this early stage. With the material shot according to the script, the only possible cuts are from the long shot to the close-up of the girl and back to the long shot. Such an extreme jump from a whole setting to a person and back to the setting must irritate the viewer. The cuts appear artificial and furthermore they direct the audience into a wrong direction, since nothing important happens which makes a close-up really necessary.

Right:

The sequence is started with a long shot to give the audience an idea of the setting. The next shot could be a medium shot, for example, when the daughter starts the question. The father answers, and during his reply a cut to the disappointed face of the daughter is made. After this the dialogue between the parents can continue in a medium shot. In this succession the sequence can be accepted by the audience, it will not expect something striking to happen and will not be distracted from the content of the dialogue.

The problem of change in picture size is equally important in documentaries.

Example:

A discussion with ten people has been filmed. Now the important points have to be highlighted and for this editing is needed. It is not advisable to join two long shots, because two shots of the same size following each other immediately result in a jump-cut. The viewer is irritated, he does not know where to place the different shots of the same size and is distracted from the content of the discussion. Now a suitable transitional shot has to be chosen. If only a short transitional shot is needed and immediately a long shot should follow, a medium shot should be inserted. One close-up between two long shots will irritate the viewer. If only close-ups have been shot and are available to the editor, it is better to join a sequence of close-ups, and to insert at least two or three close shots between the two long shots.

What is true of changes in image size is equally true of changes of angle permissible between two consecutive shots. Figure 4 shows a plan of camera set-ups in a transition from medium to close shot. In the diagram, a character stands facing the camera, in front of a rigid object on the set, say a standard lamp. From the first camera set-up we are asked to cut to a close-up. A cut from I to IIa brings on the screen a close-up in which the lamp is still in the same position relative to the character as it was in the medium shot. The cut is therefore acceptable because it is showing the same picture as its predecessor, only closer to. If, on the other hand, the close shot is taken from the camera position IIb, where the angle of shooting has been slightly changed, the resulting image will be as shown in the diagram: the standard lamp is now in a different position relative to the actor. As a result, the spectator will get the impression that the lamp has suddenly and inexplicably shifted to the left. The position of the actor's head is in both cases in the centre of the frame, but the background in IIb seems to have moved. (In practice, the effect might be cheated by moving the lamp.)

Thus the spectator will momentarily become aware of the changes and the cut will not be smooth.

If the editor wants, for some reason, to cut to a close shot which is taken from a different angle, then the angle change must be made considerably more marked. A position where the camera has been moved through 90 degrees will produce an image entirely different from the mid-shot and will therefore not create momentary confusion. The actor's face will be clearly seen in profile instead of head-on, and the spectator will therefore not expect to see the background in the same position relative to the head.

PRESERVING A SENSE OF DIRECTION

In practice, the problem of making adjacent close shots face in opposite directions is illustrated by Figure 5. Shot I establishes that the characters A and B are facing each other. Where two close shots, each taken over the opposing character's shoulder, are desired, the question of where to place the camera arises. If camera set-up IIa is used, B will still be facing left to right as he was in the medium shot. The cut will therefore be clear. If IIb is used, the close shot will show B facing from right to left. This will not make a clear transition, because the direction of of the actor's glance will have been reversed. Similarly, the same argument applies to theclose-up of A: this must be taken from IIIa as shown in the diagram.

The necessity for preserving a clear sense of direction is not limited merely to the placing of the camera. Where the actors move in and out of frame, a similar consistency in the direction of their movements must be preserved. Figure 6 shows an example. If the actor walks out of the frame to the right, it will be perfectly acceptable if he enters the next shot from the left: i.e., if we cut cut from I IIa. On the other hand, to cut to IIb would not be acceptable because it would imply that the actor instantaneously and without reason turned through 180°. If, owing to the demands of the story, it is desired that the actor should turn around in the course of his walk, then the moment at which he turns must be shown (or in some way implied).

Figure 7 illustrates the point. In a he is walking from left to right and out of frame; in b we see that he turns back; and in c we are therefore prepared to see him re-enter frame from the right. To leave shot b out, however, would confuse the spectator because he would not expect to see the action travelling right to left, and would be surprised to see the actor re-enter from the right hand side.

All these simple rules are to be taken with a certain amount of caution. In the normal way, it is almost certainly better to cut the scenes as we have indicated, but, as we shall see later, there may be exceptions when the rules need to be modified to convey certain dramatic effects.

CONTINUITY CUTTING

Continuity cutting consists of matched cuts, in which continuous action flows from one shot to another; and cut-aways, in which the action shown is not a portion of the previous shot. A continuous sequence, or series of matched cuts, may consist of various types of shots filmed from different angles. The event depicted, however, should appear as a continuous series of moving images. Whenever action continues, the players' movements, positions and looks should match through shots spliced together. A mismatch, caused by change in body position or a switch in directional look, will result in a jump-cut. This occurs because the player will appear to jerk or jump across the splice between shots.

The non-theatrical cameraman should be familiar with cutting problems. He is either his own editor, or must make editing decisions during shooting stages. Many cameramen, working for small producers, do their own cutting. Some become adept at editing, but a good cameraman is rarely an expert film editor. While theatrical motion picture production demands utmost specialization, the non-theatrical field often requires doubling or tripling specialties, so that a cameraman/director/editor combination is not unusual.

The cameraman, working this way, can develop a greater appreciation of motion picture editing problems than one who merely shoots what is requested by a director. He has a greater opportunity, therefore, to become proficient in shooting scenes that will cut together, since he is closer to the overall production of the picture than is the camera-man filming a theatrical feature. He soon learns that certain actions must be carefully observed to make them match in consecutive shots. Certain camera and player movements will cut together and others may not. Cut-in and cut-away close-ups and reaction shots can save the picture when jump-shots show up in a sequence. Cut-aways need not match previous scenes, because they are not a part of the main event. Cut-aways are shots of secondary action - directly or indirectly related to the main action - used as a reaction, a comment or a distraction. However, cut-aways should be established when they appear as part of the original long shot and later moved off-screen, when the camera is moved in to film the principal players. Later, the action may be covered with a two shot. The off-screen players' reactions are directly tied in with cut-away close-ups. In this instance, it is important that each player be shown with the proper right or left look, to match his established off-screen position in relation to the principal players. The wrong look will give the impression the player is now on the side opposite that shown in the establishing long shot.

Cut-aways need not be matched or established if they are scenes of players not shown in a previous shot. A series of man in the street cutaway close-ups may be used to comment on a verdict handed down in the previous courtroom scene. Unless alternating right and left opposing looks are desired for greater pictorial effect, a look in either direction would suffice for these shots.

A cut-away close-up may be used to distract the audience to cover a directional change in travel continuity, a time lapse or a jump-cut. These need not match. Nor need they be presented with a particular look, since they are shots of out-siders, not included in the general scene.

A close-up of a person turning his head may be inserted between two shots of a vehicle moving in opposite directions. A lengthy operation, such as the workings of a power shovel, may be shortened, and the missing portion covered by inserting a close-up of a sidewalk superintendent looking on. An inadvertent jump-cut or a jump-cut caused by removing unwanted footage may be covered by distracting the viewer with a cut-away close-up of a spectator or bystander.

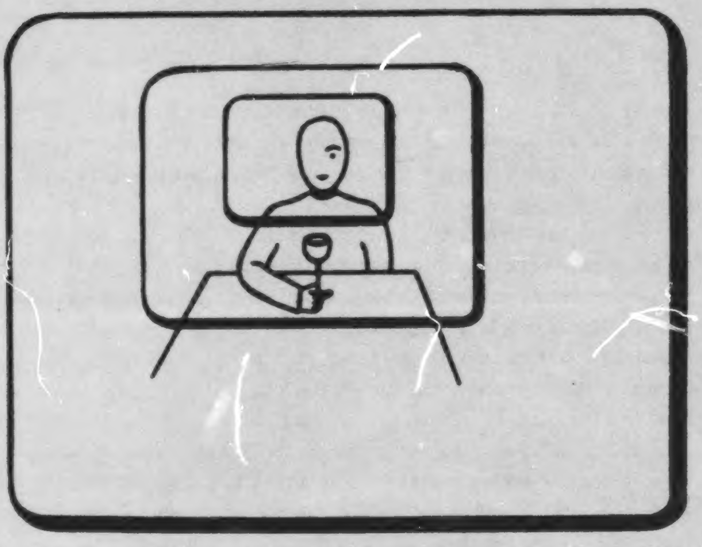


Figure 1. The three main angles: close-up, medium shot and long shot. How to cut from one to another is discussed in the text.

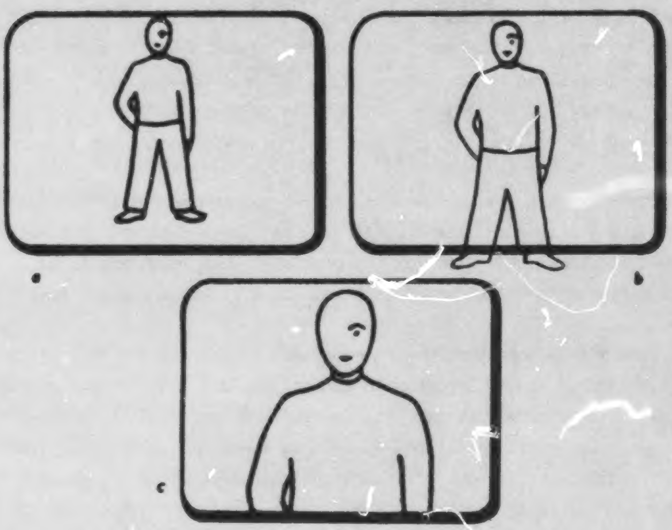


Figure 2. There is insufficient contrast between *a* and *b* to make a smooth cut; a cut from *a* to *c* makes a distinct contrast.

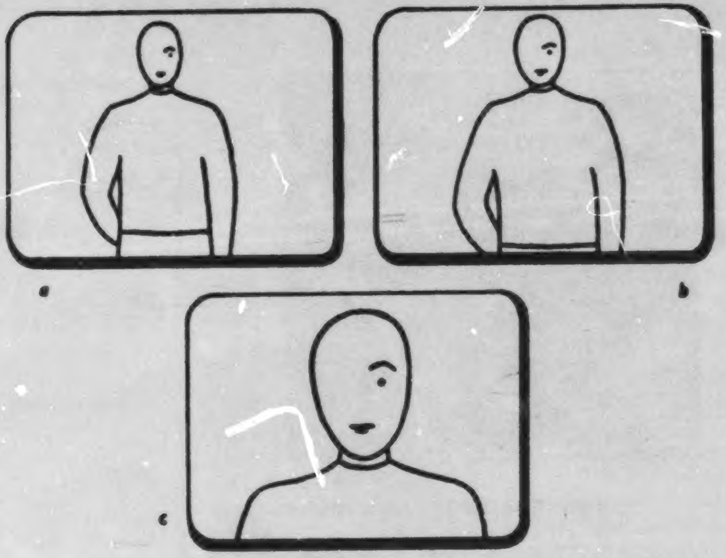


Figure 3. A cut from *a* to *b* has too small change in image size; the cut needs to be to a considerably closer image as in *c*.

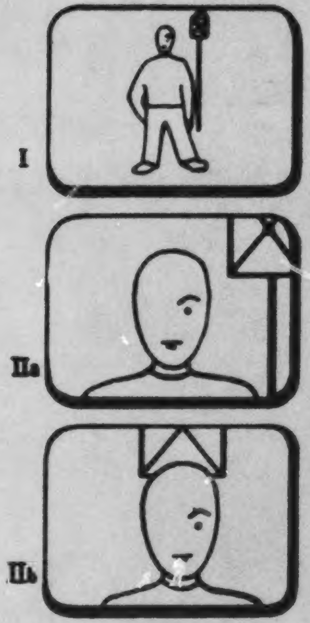
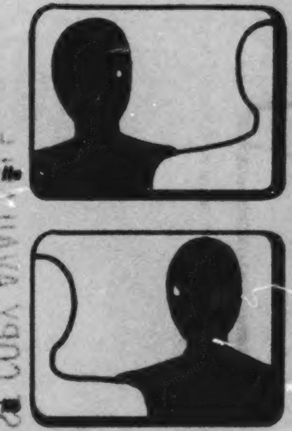


Figure 4. IIa faces in the same direction as I. IIb makes a slight change. The same angle or a marked change is to be preferred.



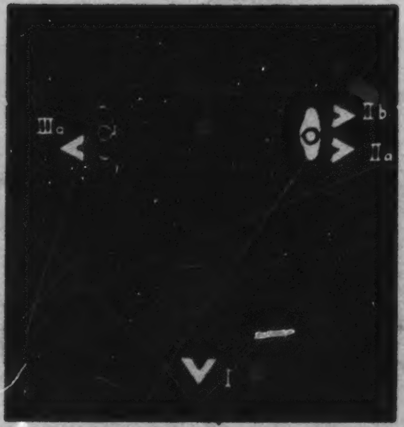
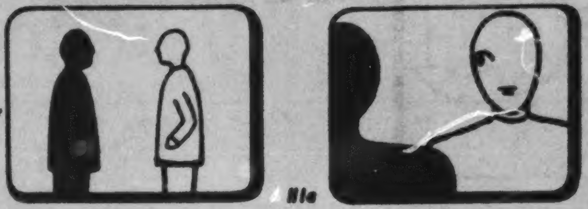
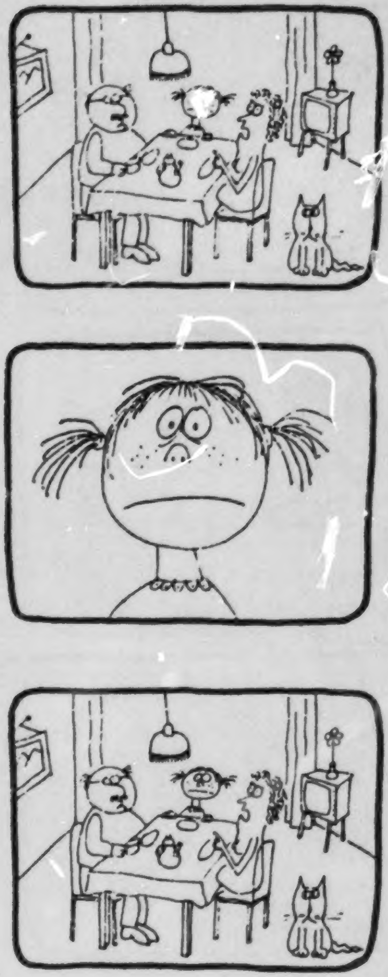

IIIa
IIb
IIa
I

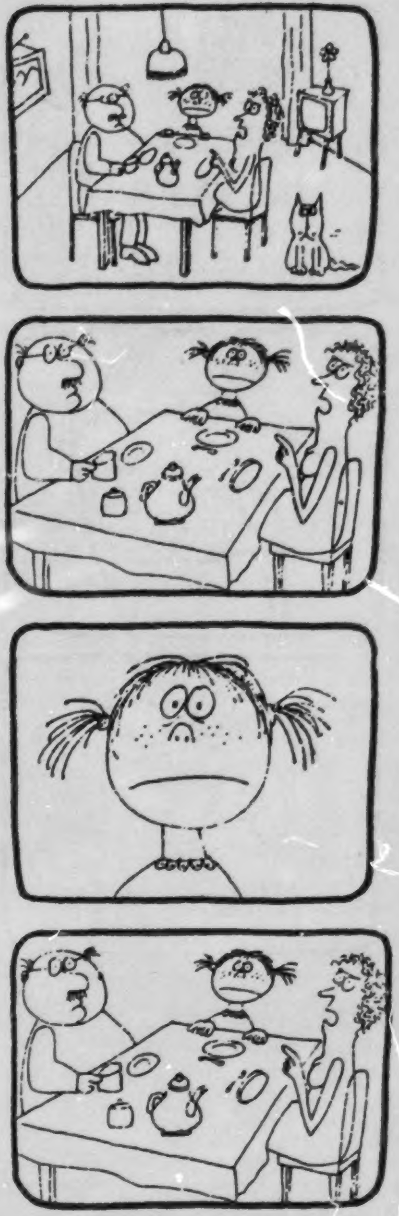
Figure 5. Cuts from I to IIa and from I to IIIa are clear; the cut from I to IIb would not be clear.



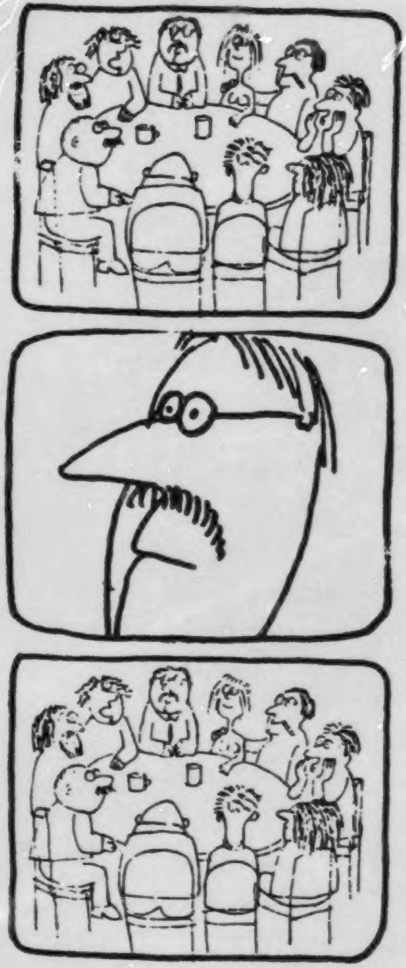
wrong



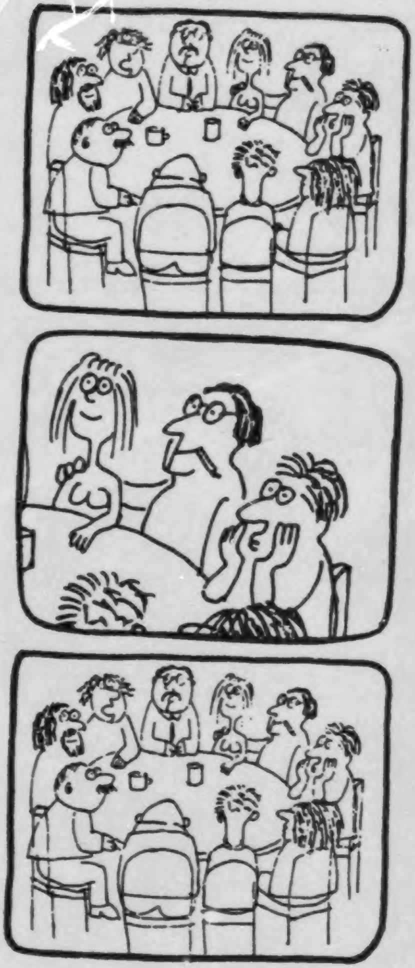
right



wrong



right



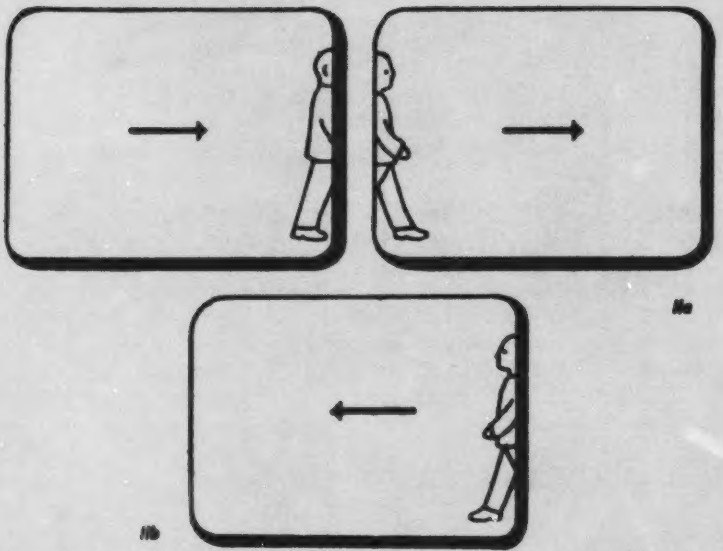


Figure 6. A cut from *I* to *IIa* maintains the same direction of view : a cut from *I* to *IIb* reverses it and is confusing.

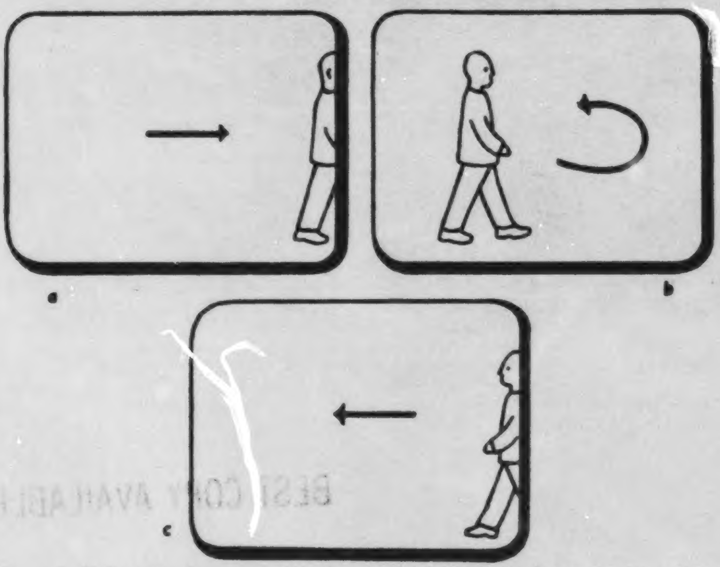
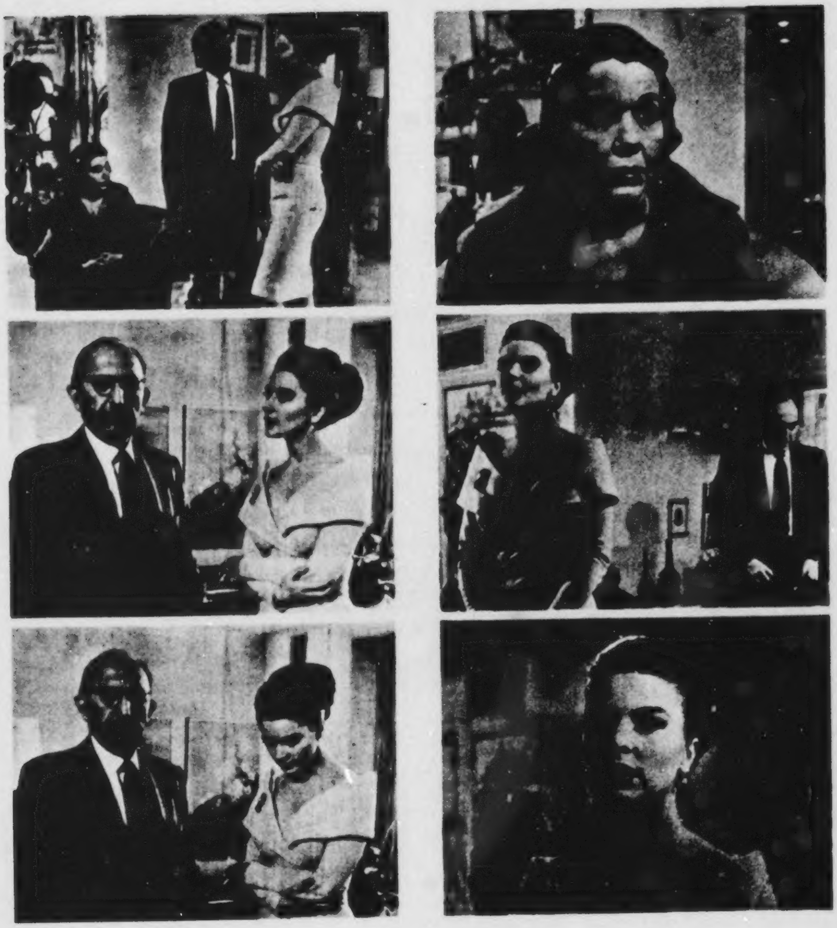


Figure 7. If the actor does reverse his direction, this should be shown as in *b* ; a direct cut from a to c would be unacceptable.



Theatrical motion pictures generally employ continuity cutting. An event is depicted in a sequence – a series of consecutive shots – in which players' movements, positions, looks and dialogue match across shots spliced together.

COMPILATION CUTTING

Newsreels and documentary-type films of surveys, reports, analyses, records, history or travelogs, generally use compilation cutting because of the animated snapshot nature of the visuals. These are connected by continuous narration. The sound track holds the narrative together and propels the scenes, which may make little sense if shown without audio explanation. Compilation cutting presents few matching problems since the individual shots simply illustrate what is being heard and need have no visual connection with one another. Compilation type films have no set form other than going from the general to the particular. Long shot may follow long shot, and close-ups which have no connection with the bracketing shots may be inserted. Every rule in the editing book may be broken if the narration makes sense and presents a coherent story. The shots themselves may move about in time and space if they are satisfactorily narrated.

Story films which utilize continuity cutting may also employ compilation cutting occasionally, such as a series of introductory long shots, a montage sequence which condenses time or space, or a series of disconnected shots to present an impression, rather than a reproduction of an event. Such compiled sequences, particularly if used for introduction or transition purposes, may employ explanatory narration.

Compilation films may utilize continuity cutting whenever a sequence of shots is required to depict a portion of the story. A series of unmatched shots may introduce a sequence which tells a little story in itself which requires matching of consecutive scenes.

Continuity cutting should be employed in a compilation film whenever two or more consecutive shots necessitates matching action.

CROSS-CUTTING

Cross-cutting consists of parallel editing of two or more events in an alternating pattern. In studio parlance, this is known as the "meanwhile back at the ranch" treatment. Cross-cutting may be employed for any of the following purposes:

To heighten interest by depicting simultaneously occuring actions in an alternate manner.

Audience interest is increased by cross-cutting back-and-forth to a related event.

To provide conflict by editing of two actions which will come together in a smashing climax. Opposing armies may advance toward each other in a gradually faster-paced, closer-and-closer series of alternating shots until they clash.

To increase tension by alternate editing of two events which have a direct bearing on each other. Editors of two rival newspapers may be shown planning and carrying out campaigns backing political opponents.

To heighten suspense by keeping the audience in a state of anxiety as events move toward a climax. Scenes of the police searching a building for a time bomb may be cut back and forth with close-ups of the bomb ticking in a closet.

To make comparisons among people, objects, or events. Cross-cutting may alternately depict each phase of an engineering test between two competitors manufacturing similar items.

To depict contrast among people, countries, cultures, products, methods or events. Contrasts may be shown between old and new methods of farming, manual and automated manufacturing procedures, life in the tropics and the Arctic.

The first shot in a series of cross-cuts should be treated as an establishing shot and allowed slightly greater screen length than the following cross-cuts. This will give the audience a frame of reference with which to compare the cross-cut event. Introductory cross-cut shots should not be thrust on the screen without identification, unless audience confusion is an important story factor. In most cases, the audience should be immediately aware what is happening, and who is involved, and where the cross-cut event is occuring - if that is a pertinent story point.

Cross-cutting should not be regarded as a strictly theatrical fiction-film editing device. It may be used advantageously in documentary fact films, particularly when it is employed to connect, contrast or compare two or more actions or events. Parallel editing of two or more events provides a welcome departure from straightforward story-telling, because it heightens audience interest and moves the story about in time and/or space.

MOVING SHOTS AND STATIC SHOTS

Moving and static shots may be inter-cut only under certain conditions. A series of moving shots will generally inter-cut without difficulty if the tempo of the camera movement is properly maintained. The series may be the same subject filmed from various camera distances and angles, or of different subjects filmed in a repetitious manner.

Movement may also be introduced in a static establishing shot and then filmed with a continuously moving camera. Two actors may walk down a street in a static long shot. The medium shot that follows may be filmed with a continuously moving camera. Individual close-ups of each actor may also be shot with a moving camera. The sequence may end with a static long shot as the actors enter a building. In this case, static shots would be cut directly and effectively with moving shots, because the movement was begun in a static scene and picked up on the move with a moving camera.

This treatment would also work in reverse, by opening with a walking medium shot of the players filmed with a continuously moving camera, and then cutting to a static long shot to show their progress down the street. More moving shots may be made if desired, and the sequence ended with a static shot as they enter the building. Continuous player or vehicle movement may be carried across both static and moving shots. A series of continuously moving shots, of the same or different subjects may also be inter-cut successfully. A continuously moving subject may be filmed from various distances and angles. Or, the camera may employ repetitious movement, such as a pan or dolly, or static subjects. The moving camera may film a moving car from the front, rear and side in long shot, medium shot and close-ups. Or, the camera may dolly toward a building, down a hall, through a room; or toward several similar objects, such as various types of tools, for comparison. The shots may thus be directly or indirectly connected with each other. Similar camera movement is used to tie subjects together.

However, inter-cutting static and moving shots of static subject matter is generally difficult, because the switch from a static shot to a moving shot (or vice versa) is abrupt and jarring due to lack of subject movement. As example, a static close-up of a dial on an instrument panel cannot be successfully edited into a continuous pan shot of the entire panel. In order to cut it into the moving pan the close-up would have to be filmed with the same camera movement. Since it would sweep past the dial and provide only a fleeting glance at the reading; such a panning close-up would defeat the purpose. It would be best in this case to shoot both shots with a static camera; or to pan to the point where the close-up will be cut in. Then, static footage should be filmed, and panning continued.

A pan, tilt or dolly shot of a static subject, preceded or followed by a static camera shot, should always be filmed with a static camera at the beginning and end of the shot. Thus, the cut will be across static frames, with the movement sandwiched in between.

It is very jarring to cut from a static shot of a static subject to a moving shot that begins moving immediately; or to go from a continuously moving shot of a static subject to a static shot.

A moving shot should always be considered in relation to the bracketing shots that precede and follow it. Shots of moving subject matter will generally offer little or no editing difficulties, because player or vehicle movement can be carried across either static or moving shots. Moving camera shots and static camera shots of static subject matter may result in editing problems, because the abrupt introduction or cessation of image movement across a cut will jar the viewer. However, a combination of a static shot of static subject matter, and a moving shot of a moving subject will inter-cut if properly motivated. These combinations occur in cut-away shots, such as a cut from a static shot of the heroine tied down to the railroad tracks to a continuously moving shot of the hero riding to her rescue! This situation further reinforces the editing rule that it is possible to cut away to anything happening anywhere at any time.

TIMING MOVING SHOTS

The screen length of a pan, tilt, dolly or other moving shot should be considered in relation to its editorial value. The screen length of a moving shot is based upon the time the camera is in motion, while the screen length of a static shot is based on subject action. A moving shot must be used in its entirety (or any continuous portion) because it is difficult, if not impossible, to cut during camera movement. A static shot, on the other hand, may generally be trimmed shorter or cut into several shots. This applies particularly to static subject matter or action performed by actors in more or less static positions. It does not apply to moving shots of travel action, such as a vehicle or player in motion, which may be cut to any desired shot length.

For example: a static long shot of a worker assembling a power tool may be edited in several ways.

It may be used in its entirety; it may be cut into several shots; or it may be used as establishing or reestablishing shots to open and close the sequence. Medium shots and close-ups may be inter-cut at any point. A moving shot, such as a dolly in or out, or both, would be very difficult to inter-cut with other shots except where the camera is at rest. The editor may be forced to leave in a lot of superfluous footage, simply to arrive at a medium shot or close-up where the camera paused in its travel. Thus, useless action, which would be trimmed out in static shot, may have to remain in a moving shot - to preserve the movement, or to avoid a cut during movement.

Paradoxically, straight cuts are always faster than moving shots, because they come to the point immediately. A moving shot, such as a long pan or dolly shot often contains much useless footage included simply to allow the camera to "go somewhere". The camera should record significant action en route - not at its destination.

Many cameramen and directors mistakenly believe that a moving shot contributes flow to the story-telling and speeds the screen action. In many instances, movement slows the screen story because it takes longer to come to the point! Unless the camera move is dramatically motivated, it is much better to shoot several static shots that may be straight cut, rather than a long moving shot which drags from one significant bit of action to another.

Moving shots, timed to a sync-sound or narration track, will generally present no problem because the movement is justified by length of sound track involved.

PROTECTION SHOTS

"Protection" or "cover" shots are extra scenes filmed to cover any unforseen editing problems, or to replace any doubtful scenes that may present editorial difficulties because of wrong timing, excessive length, possible mis-matching, lengthy pan or dolly shots, etc. They may be additional shots not indicated in the script or duplicate scenes filmed in a novel manner.

A particular scene may be editorially doubtful when filmed if there is a question concerning its cutting. Since editorial decisions are often difficult to make during shooting, and since the choice should be left to the editor, it is wise to shoot protection shots.

THE ELEMENT OF TIME AND TIMING

The ability to shorten (or lengthen) the screen duratin of an event is a most important factor in the editor's control of pace. In the cases we have mentioned, the shortening of an interval is brought about by implying that the piece of action is taking place off screen. But this principle of condensing real time can often be carried a stage further. It is sometimes possible to join two shots in such a way that the action is ostensibly continuous, yet, in fact, a portion of the movement has been omitted.

Say, for instance, an actor is seen running away from camera towards an ascending flight of steps. The camera is behind the actor and it is intended that as he reaches the steps we should cut to another closer shot facing across the flight which will show him jumping on to the first step. Now, strictly speaking, the two shots should be matched: the point in the action at which the first is cut should be taken up by the second.

In practice, this may not always be necessary. In the course of the first shot there may come a point when the spectator will begin to realise that since the actor is running towards the flight, he will jump up the first two or three steps when he actually gets there. In such a case, it may on some occasions be acceptable to cut to shot b a few feet before the actor has reached the bottom of the steps in shot a. The fact that the cut is mechanically wrong does not matter unless the spectator can notice the error, and the chances are that it will pass unnoticed. The idea "he is going to jump" is planted in the first shot and the actual leap is shown in the second. The impetus of the idea is so strong that it makes the mechanical discrepancy appear unimportant.

The ability to lengthen or shorten the duration of an event in bringing it to the screen gives the director and editor a highly sensitive instrument for the control of timing. We have seen how unimportant intervals can be bridged and how certain actions can be shown on the screen happening much faster than they do in real life. But the control of timing which the film-maker gains through editing can be used for more positive purposes than the mere cutting down of unnecessary intervals. It enables him to present a series of consecutive events in such a way that each new development is revealed at the dramatically appropriate moment. This applies to the spacing of events within the whole story as well as to the timing of individual cuts.

In order to get a clear picture of the full advantages which are derived from the purposive timing of cuts, it may be useful to consider two passages from a film which did not employ cutting at all: by assessing the loss in dramatic effectiveness which is incurred by discarding the factor of editing, we should be able to get a clear picture of its real value.

Two short extracts from Alfred Hitchcock's film "Rope" are given below. The film was an experiment in which the director attempted to construct a *continuity* entirely *without cuts*: the action was kept moving by means of a continuously moving camera:

(1) Two young college students, Brandon (John Dall) and Phillip (Farley Granger), have killed their fellow-student, David Kentley. Out of sheer bravado, they plan a party on the night of the murder to which they invite their old schoolmaster, Rupert Cadell (James Stewart), and the murdered boy's parents. Throughout most of the party, the boys succeed in hiding from their visitors the fact that they have seen David on the same night: they pretend to have invited him and feign surprise at his lateness. Rupert notices their strange nervous behaviour and begins to become suspicious. Then, as he is ready to depart, he goes to fetch his hat from the maid and accidentally finds the first material clue to the boys' guilt.

In a mid-shot of Rupert and the maid we see her handing him a hat from the cupboard. Rupert absent-mindedly puts it on: it is the wrong hat, for it is obviously too small for him. He takes it off, lowers it down in front of him and suddenly notices something inside.

As Rupert holds the hat in front of him the camera slowly moves in to a close shot, and reveals that there are initials inside the hat - the initials of the murdered boy. (In order to let the camera pick out this detail it was necessary for Rupert to tilt the hat to one side and wait for a period of about three and a half seconds (5 feet of film) while the camera was moving in.) Then, when enough time has been given to the audience to identify the initials, the camera slowly moves up to show Rupert's expression as he suddenly realises what has happened.

(2) Toward the end of the same film, Rupert has returned to the boys' flat to question them about David's disappearance. He has in his pocket the rope with which he suspects the boys strangled their friend, and is now ready to force them to confess.

Rupert is standing with his back to the two boys. The camera is holding a close shot of his pocket: we see him take the rope from it. He is talking obliquely about a murder, not referring to the details of the scene, but in a tone which makes it clear that he knows what has happened. Suddenly he turns around to face the boys, holding the rope in front of him - giving the final proof that he knows who murdered David. While he goes on speaking, the camera slowly pans away to the right, recording in its path first the corner of the room, then a neon sign visible outside the window, and then finally reaching the reaction shot of the boys. It takes the camera 10 feet to reach the boys and a further 5 feet to come to rest on them.

Both these extracts show how the timing of effects is dulled by the inability to use cuts. In the first passage, there is a simple instance of how an effect can be wasted through bad timing. At the moment we see Rupert pausing to identify something inside the hat, the dramatically important image becomes what he sees. In the course of a normal film, the editor would at this point cut straight to a close-up of the initials, thereby giving the impression of showing the reason for Rupert's hesitation. The first image gives a dramatic motive for showing the second and the continuity would therefore be clear and incisive. In the way the scene has been managed, there is a dramatically meaningless interval between the time Rupert sees the initials and the close-up. The camera movement does not contribute to the effect, it merely delays it by a meaningless - and psychologically inappropriate - device. What matters in the scene is the shot of Rupert (i.e., the image seen before the camera starts moving) and the close-up of the initials (i.e. the image seen at the end of the movement).

No purpose can be served by making a camera movement intervene between the two.

Similarly, when the close-up has been on the screen long enough to let the spectator identify the initials, the next significant event is Rupert's reaction. In a normal film, a cut would have taken us from the one to the other: a clear dramatic cause-and-effect relationship would have resulted. The slow retreating of the camera merely blunts the effect.

A similar process can be observed in the second example. At the precise moment that Rupert turns around, the two boys know that they have been found out. The next significant event is their reaction. If the film had been normally edited, the editor would at this point have cut to the reaction shot so that the spectator could immediately see the effect of the previous image. As it is done here, there is a considerable interval between seeing the rope and the boys' reaction.

It may be objected that this delaying of the reaction shot was intentional, that the director wanted to keep the spectator in suspense. This would, of course, be a perfectly justifiable interpretation of the scene. But even if this was the intention, it is questionable whether the delay has been achieved in the most effective way. After the camera begins its panning movement, it reveals on its travels a series of objects which are completely irrelevant to the situation. The image of the neon light outside - in itself a picturesque but utterly insignificant detail - does nothing to reinforce the tension. The delay in the reaction is brought about by showing the audience something that has nothing to do with the story: the dramatic conflict is momentarily side-tracked.

If the director had not been bound to this particular formula of presentation, he could have delayed the reaction equally well by cutting.

He could have left the shot of Rupert on the screen for as long as he felt necessary: the cut to the boys' reaction could then have been made at the point when the director felt that the suspense had been held long enough. The advantage of this method of editing the scene is that the spectator would all the time be watching something on the screen that is part of the conflict. Holding the shot of Rupert would not have decreased the suspense to be dervied from delaying the reaction: on the the contrary it would have increased it, because the spectator would all the time have been watching images relevant to the cat-and-mouse game being enacted on the screen.

In making a comparison between the continuity of "Rope" and that of a normally edited film, several points emerge. It must be obvious that, had the two scenes been edited, the dramatic effects would have been achieved more incisively. The exact moment at which the image of the two boys' reaction should be seen could have been selected - after some experiment on the cutting bench, if necessary - and then carried into practice; the precise moment at which it becomes important that the spectator should see the initials inside the hat could have been chosen and then used. The editor could have timed the effects to best advantage without being hampered by any of the physical complications of long camera movements. If the scene had been shot from the requisite number of camera angles, he would have been able to do this with complete freedom. Where a general lack of dramatic precision is the overall impression created by "Rope", a precise, dramatically taut continuity could have been achieved.

The effect on the total impact of a film made in this way can be imagined. The five feet of camera movement which the camera takes to burrow into the hat is a complete waste of screen time. If this loss of time is multiplied by the number of times it must occur in the course of a complete film, one gets a picture of the overall loss of pace which must result. If suspense is aimed at, the spectator must first be shown what to wait for.

If a shock is intended, the prewarning must be, so to speak, negative: the spectator must be deliberately led away from the significant event before it can come to him as a surprise.

The choice between anticipating a climax and bringing it on as a surprise arises on a more routine level every time an editor cuts to a close shot. The question arises when a particularly startling event is just about to occur - say a character is just about to take poison - whether to cut to the close-up at or before the crucial moment. If the cut to the close-up occurs some time before the actor swallows the poison, then the very fact that a close-up has come on the screen will make the spectator anticipate a climax and feel suspense for it to happen. Alternatively, if the cut to the close-up coincides with the moment the lips touch the glass, it will come as a surprise. In the example we have just quoted, the editor, after giving the spectator a shock, chose to hold back the really frightening image for a further fourteen frames, thereby adding a momentary uncertainty and suspense before the final revelation.

The variation of pace is significant only in so far as it quickens or dulls the spectator's interest in what he sees on the screen. In any discussion of it, it is therefore important to distinguish between the pace created mechanically - by simply making the images come on the screen at a faster rate - and the pace generated by the inherent interest of the story. A sequence can be at once fast-moving and dull - witness the chase at the end of almost any second-rate Western: or it can be slow-moving and tense - witness some of the famous Hitchcock suspense scenes.

A superficial impression of fast, exciting action can often be created simply by cutting a sequence at great speed. Making images follow one another faster and faster in itself produces an effect of increased excitement and can be used to strengthen the story's interest. But it is important that this speeding up of the cutting should be carried out with the closest attention to the content of the shots. In attempting to increase the rate of cutting, it is useless to look at the absolute lengths of the shots and then arbitrarily reduce them.

A sequence composed of shots each about five feet long can, under certain circumstances, appear much slower than another sequence employing strips of film twice this length. Each image tells its own story and must therefore be considered individually. One image will convey all its meaning in a short space of time another will take longer: this must be taken into account if the increased rate of cutting is not to lead to obscurity. For even if a sequence is to stimulate the spectator's interest primarily through the increase in pace, it is still necessary that each shot should remain on the screen long enough to be intelligible.

For instance, if the director wishes to show an insert of a letter on the screen, the length of time for which he will have to hold it obviously depends on the amount of writing the letter contains. There is a definite length of time which allows the average spectator to read all the words. To hold the shot for a shorter time than this means withholding part of its information; keeping it on the screen longer means boring sections of the audience while they wait for the next shot. An image of an actor running from one place to another must be shown in full if its complete meaning is to reach the audience. To cut away from it before the actor has reached his destination, because it happens to be desirable that the sequence be cut faster, will mean that part of the shot's information is with-held from the spectator. On the other hand, an insert of a static object - say a close-up of the revolver in the killer's hand - merely establishes that the killer is, in fact, holding a revolver: a few seconds will suffice to allow this shot to convey all its meaning.

Similarly, where a long shot of a piece of action must usually be left on the screen for a considerable interval of time to let the spectator identify the action, a close shot makes a much more direct appeal and is more quickly comprehensible. Thus - and we are talking here in much too general terms to suggest any definite rules - it will normally be permissible to hold the close shot for a shorter time than the long shot.

Having considered the content of each shot and the size of its image, there is a further factor to be taken into account: the context. A shot which introduces an unexpected fact to the audience must be left on the screen longer than one which merely reintroduces something familiar. We shall have more to say about this later. Meanwhile, all we can suggest is that each shot, in order to be intelligible and to convey all its meaning must be held on the screen for a certain minimum length of time. That minimum is determined in each case by the size of the image, its content and amount of movement within it, and the context. It is not, of course, implied that this "critical" length of a shot can be precisely calculated, or even that it should be were that possible. The point is that when an editor is assembling a sequence with a view to giving it an extremely fast tempo, he must bear in mind the particular characteristics of each shot.

Cutting down shots to their minimum length is not, however, the only method of creating an impression of speed. When a sustained impression of rapid action is desired, it is often better to achieve this through varying the pace rather than by keeping to a constant maximum rate. In the documentary "Merchant Seamen" although a whole sequence is concerned with an extremely rapid series of operations, the pace of presentation is continually varied. The fast passages are deliberately punctuated by slower ones, and this very variation accentuates the impression of speed. If the whole passage had been edited at a rate employed at the climax, the constant maximum speed would soon have become monotonous. The effect of urgency which is conveyed to the spectator depends on the contrast with what has preceded: the acceleration of tempo evokes a much greater feeling of fast activity than would a constant maximum rate of cutting.

The effect which the rate of cutting has on the spectator is further governed by the nature of the shot juxtapositions. Commonly the passages in which the very fastest cutting is employed are sequences in which two parallel streams of action are cross-cut.

Here the spectator comes to recognise the pattern of the continuity and expects the cut from pursuer to pursued. Each cut makes a point which the spectator can immediately take in and the cutting can therefore be made extremely rapid. In another passage where the cuts take us to new, widely divergent images, each shot must be left on the screen for a considerablylonger interval in order to allow the spectator enough time to get accustomed to each new image.

The problem of maintaining an appropriate space in the presentation does not end here. Bedies controlling the rate of cutting within a sequence, the editor must also evolve suitably timed transitions from one scene to the next. In practice, this presents a choice between joining two consecutive scenes by a cut, a dissolve, or a fade.

The most usual way of joining two consecutive sequences is by means of a dissolve. The artificial pictorial effect creates a discontinuity which clearly separates the adjacent scenes. Through years of usage, moreover, the dissolve has come to be commonly associated with a passage of time. If therefore, the editor wants to imply that the second scene is taking place some time after the first he will introduce the second scene through a dissolve. Equally, a flashback, which takes the story back in time, is commonly introduced and terminated in a dissolve: provided that the time interval is clearly brought out in the action - by changing the characters' appearance, the locale, or the time of year in the adjacent scenes - the spectator will have no difficulty in following the story.

To use a dissolve merely to bridge a passage of time between two consecutive pieces of action is, however, not always desirable. In the previous section we discussed the case where a scene taking place in the street outside an apartment house is to be followed by a further scene in the third floor flat of one of the characters. We saw that a phrase of dialogue could effectively link the two scenes in such a way that a cut from the one to the other would make the transition acceptable. In a different set of circumstances the two scenes could have been linked through a dissolve and the transition would of course have been equally smooth.

Dramatically, however, the two transitions would be somewhat different. Joining two scenes by means of a dissolve introduces a discontinuity; it creates the impression that one scene has finished and another is beginning. If the scenes are linked by a cut in the way we previously suggested, this break in the action does not become apparent. The sequence appears to be continuous and the dramatic flow is not interrupted. It is of course not possible to say which of the two methods is preferable in the case we have quoted without taking into account which of the two possible dramatic effects is more suitable to the story. But it is worth noting that the automatic use of dissolve to bridge any two sequences, which is so common in contemporary films, often leads to inappropriate continuity effects. The dramatic pause which is implied by a dissolve is by no means desirable when one scene happens to be giving way to another.

Dissolves can sometimes be used for a more positive purpose than we have described. It is sometimes possible to make the few moments in which the two images are left on the screen together hold a specific dramatic significance.

The use of fades is a more specialised matter. A fade expresses a more pronounced pause in the continuity: it breaks the narrative flow and seals off the action which preceded from the action that follows. Where this is the intention, fades can often be highly effective. Some film-makers, on the other hand, hold that fades should not be used at all, on the grounds that a blank screen is a meaningless thing to show to an audience. There is no point in taking sides on this issue. All that need to be said is that a fade, when properly used, can sometimes produce a necessary pause for reflection and give the audience a moment to absorb a dramatic climax. It may thus, if properly timed, be deliberately used to exploit a dramatic carry-over to the following scene.

Other optical devices are sometimes employed to join consecutive scenes. A wipe may sometimes be used instead of a dissolve and an iris may on occasion introduce or close a shot in a more telling way than a fade. The use of these special optical devices is however, at present rather out of fashion. This is not to say that they may not, at some time in the future, again pass into common usage. The choice between them is largely a matter of currently accepted convention: at present, film-makers seem to prefer the pictorially less artificial effects, namely fades rather than iris shots, dissolves rather than wipes.

So far we have discussed the question of timing of cuts in relation to individual dramatic effects and in relation to the larger requirement of the overall pace of the sequence. We must now turn to the less easily definable factor of film rhythm which imposes a further discipline on the editor's timing.

The problem of cutting shots in a suitable rhythmic relationship is a matter of small, hardly perceptible variations in length: it is difficult to discuss in general terms because the precise shortening or lengthening of each shot depends so closely on its content, and because the importance of correct rhythmical assembly can only be appreciated on viewing a sizeable length of film. Further, where a faulty or jerky rhythm has been imposed on a scene, the effect will usually be clearly felt; where a sound rhythm has been achieved, the effect will appear natural - as if no effort of timing had been involved.

SOUND EDITING PROBLEMS

Match-cutting sync-sound scenes is inherently more difficult than cutting silent scenes. Action only need be matched in silent scenes. If the action depicted in the edited picture conveys the meaning of the original event, the result will generally be satisfactory.

However, lip-sync-sound pictures, in which dialogue *tells* the story, must be cut to the sound track. Since the audio record is *anchored* to the picture, the editor is limited in juggling the visual images. In so doing, he may alter or completely ruin the meaning of the dialogue. Cutting to sync-sound compels the editor to accept whatever is available for the particular section of sound track in question. His only choice is either to use the shot or discard it. It is possible, of course, to juggle the sound track itself by transposing words and using other editorial tricks.

Match-cutting dialogue scenes require that player action or movement across straight cuts match precisely. The editor can choose any point in a silent shot where the turn of a head or the wave of a hand matches the end of the previous shot. Match cutting dialogue shots offers no such choice. The editor *must cut to the sound track* and accept whatever action is portrayed. Strict visual and audio continuity must be maintained during filming, so that both *dialogue* and *action* are matched across straight cuts. Unless players' positions and looks are duplicated when camera is moved, a jump cut will result.

Dialogue scenes are almost always filmed from a prepared script, so that continuity of dialogue is easily maintained. Since, however, the emphasis is generally on what a player says, rather than on what he does; the cameraman and/or director must take great care to match player movements, positions and looks. Dialogue scenes should be carefully rehearsed with emphasis on what a player does, and where he stands or moves as he speaks his lines. This is particularly important if the *master scene* technique is used, and players must repeat their actions and dialogue in closer shots. If both action and dialogue do not match precisely, the film editor will have difficulties in match-cutting the sequence. Such action mis-matches may force the editor to cut to reaction shots of the listening actor, or resort to cut-away reaction close-ups of other players, because they offer the only solution to covering a jump-cut. If the *triple-take technique* is used, and the sequence is filmed shot-for-shot, both action and dialogue should be overlapped to insure match-cutting.

So far we have dealt only with negative considerations: we have merely described the editing mistakes which must be avoided if a mechanically smooth and physically lucid continuity is to be achieved. We must now turn our attention to more positive problems, to see how a dramatically apt continuity can be evolved.

We have insisted that, whenever a cut is made, there must be a good reason for it: to transfer attention, however smoothly, from one image to another, when the previous image would have answered equally well, can serve no useful purpose. To say this is not merely to state an empty rule: making a cut for a specific dramatic reason may often become a simple matter of necessity, for unless it makes a point a cut is often found to be unsmooth. If, for instance, we cut from a mid-shot to a close-up of a character, there may be no mechanical reason why it should not be acceptable. If the cut marks an important dramatic development it will, in fact, usually be effective. Yet the same cut in a different context may become harsh and unacceptable. If we were to cut to a big close-up just as the actor was saying, "I'll have two lumps of sugar, please," the cut would be emphasizing a dramatically insignificant gesture and would appear meaningless to a spectator. It would, in other words, not be a smooth cut.

Thus, although the mechanical rules of cutting must be kept in mind, the decisive consideration at the junction of any two shots must be that the transition should be motivated by dramatic necessity. A continuity of shots in which each cut is dramatically useful will often appear smooth even if the mechanical matching is imperfect.

Take an example. A man is sitting in an arm-chair. He has put a cigarette in his mouth and is searching his pockets for matches. It is clear that he cannot find them. He glances around the room and suddenly a look of recognition comes over his face: he gets up and walks to the other end of the room, where a box of matches is lying on a table. There are two entirely different ways in which this scene could be cut. The whole action in the chair could be played in one shot and cut to another matching shot which takes up the actor's movement and pans with him as he walks to the table. The cut would be mechanically smooth and the action would be clear.

Now let us look at an alternative way of editing the scene. The first shot could be shown as before. Then, when the actor recognises something off screen and is just about to get up, we cut to what he sees, namely a shot of the matches lying on the table. The shot of the matches is now held until the actor walks into frame and we see him pick them up. At the moment the actor looks up, the spectator wants to see that it is that has caught his eyes. At this moment there is a motive for cutting: the cut makes a point because it identifies the reason for the actor's movement. In the first method of cutting the scene the cut made no point: no idea was carried across it - the joining of the shots was a simple physical necessity which could have no significance for the spectator. In the second case, the cut made a point: the first shot caused the second, and the continuity was therefore more incisive.

In comparing these two methods of cutting a scene, it would be wrong to insist that every cut should be motivated in the way we described in the second example. There are obviously a great number of cases - such as when a character has to be taken from one room to another - where it is physically necessary to shoot the scene in two separate takes and simply join them to form a continuous movement. One can, of course, not make a hard and fast rule. What does seem clear is that a series of dramatically apt cuts is generally continuously and never allows the presentation to become a passive record.

There is, moreover, a further advantage to be gained from editing the scene in the second way. Say, for example, it takes the actor ten steps to cross the room and reach the matches. In the first case, where the whole movement has to be shown, all the ten footsteps must be seen if the continuity is not to become jerky. In the second case the man's walk is not shown at all. From the moment at which we imply that he is about to rise, we cut to the matches. Then after a very short time of holding shot 2 on the screen, the actor can be allowed to enter frame. The spectator, interested only in the sequence of significant events, will not notice any physical inaccuracy. The editor is able to reduce the screen time of the scene by simply cutting out the interval during which the actor is crossing the room. In other words, he is able to edit the scene in such a way that the significant events are shown in full and the physical movement is unobtrusively cut down to a minimum.

In cases where a character has to be conveyed from one place to another between two consecutive scenes, this principle of implying the unnecessary intervals can be carried a stage further. For instance: A is shown talking to B in the street just outside the apartment house at which he lives. We see him taking leave of his companion, and the script demands that the next scene should take place between A and his wife, in his third floor flat. Now if the transition from the first scene to the second were to be shot strictly as it would happen in real life, it would be necessary to show A entering the house, pushing the button to call the lift, waiting for the lift to descend, stepping into the lift, ascending to the third floor, getting out, walking up to the door of his flat, and opening the door. Only after all this could the second scene commence. Unless there is some dramatic point to be made in the course of the journey, this is clearly an unnecessary waste of time. The time gap between the scene in the street and the scene in the flat must in some way be bridged.

Several ways suggest themselves. As the two men are seen parting in the street, the camera could stay on B and let A walk out of the frame, obviously towards his house. Then, after B had been held on the screen for a little time, a cut could take us straight up to A as he was entering his flat. The period of time during which B was held on the screen would be sufficient to imply that A had meanwhile had time to ascend to the third floor.

Alternatively, it would be possible to cut the scene in another way. As the two men are parting, A might say something to the effect that his wife is waiting for him at home. The line of dialogue would justify a cut straight to the interior of the flat where the wife is waiting. After a very brief period it would be permissible to cut to the inside of the flat door and show A entering. The spectator will not mind seeing A entering the flat a few seconds after he was seen in the street: it will appear to him that the short time in which the shot of the wife was held on screen was sufficient to let A ascend to the third floor. It will be seen that the physical continuity is wrong, yet because the order of events is dramatically significant, this does not matter. From the street scene where the wife's name is mentioned, the logical cut is to a shot of the wife herself. From the shot of the wife waiting for her husband, the logical cut is to shot of A entering.

In each case the idea of the scene is carried over into the next and the dramatic continuity is strong enough to make the spectator ignore the physical inaccuracies.

EDITING PROCEDURE

Editing involves arranging all the material available for making the film, deciding what is to appear in the final print and how it is to be presented and the preparation of this material for printing. The function of the editor varies in different types of production, and according to the size of the film unit. In some cases, especially if the script is imprecise, the editor's job may well be equivalent to post-scripting the film. Also the editor's job almost always includes a certain amount of disguise or cheat, since he has to make the best out of the material that sometimes has not come up to expectations.

There is one resounding generalization to be made: that is that all editing must be carried out meticulously. Good editing need not pass unnoticed, but if it is successful, it will be the total effect of the film rather than that of the editing which comes over.

THE CUTTING COPY

All the initial stages in the editing of a film are normally done on a rough copy, known as the cutting-copy (c/c) or workprint. This is a direct ungraded contact print of the master print or negative which is used only for editing purposes. It's main function is to protect the original. After the editing of the cutting-copy, the master is matched to the cutting copy and from the once cut master, the prints are made.

Cutting-copies are of several types: from a b/w master, ordinary b/w rush prints are supplied. For many types of film it is quite satisfactory to cut colour film on a b/w workprint, but there are two points to watch. If the workprint is done on blue-sensitive orthochromatic film instead of the slightly more expensive panchromatic stock, edge-fogging on the master is not transferred to the copy. So for shots that occur near the end or the beginning of a master roll, the scene must be checked against the master. Since in most films the colour itself is a factor which needs taking into consideration while editing, it is well to check through the master in order to assess its colour quality. If the budget allows it however, it is always useful to have a colour cutting-copy.

The camera master should be put aside, well wrapped and in a can, and should not be opened unless really necessary. The cutting-copy will be wound either on a plastic core or on a cardboard center, in which case it should be soon transferred on to a core. During the editing work, all picture film and sound film is kept on cores: usually 2'' diameter T cores for length up to about 400 ft., and 3'' Z cores for longer rolls. Even when the sync. footage is not yet assembled, a brief run of the copy through an editing machine or through a projector will give some initial idea of the look of the film. This first run will tell the editor whether all shots are well exposed, if all important shots have worked out well enough to be used, and many other general points. The first screening of the rushes is normally the most disappointing time of the entire film, since all the shortcomings of the shooting are only too visible and none of the solutions provided by editing have yet been found.

The editing room should have the following:

Synchronizer
Viewer (if not incorporated in the synchronizer)
Rewinds
Tape splicer
Split tools
Trip bin, clip rack or other trim filing system
Log book or sheets
Notepaper
Gloves
Cans
Cores
Scissors
Chinagraph pencil
Gem marker
Pen or pencil
Tape
White leader
Black spacing
Bins

SPLICING

There are two ways of splicing film: tape splicing and cement splicing.

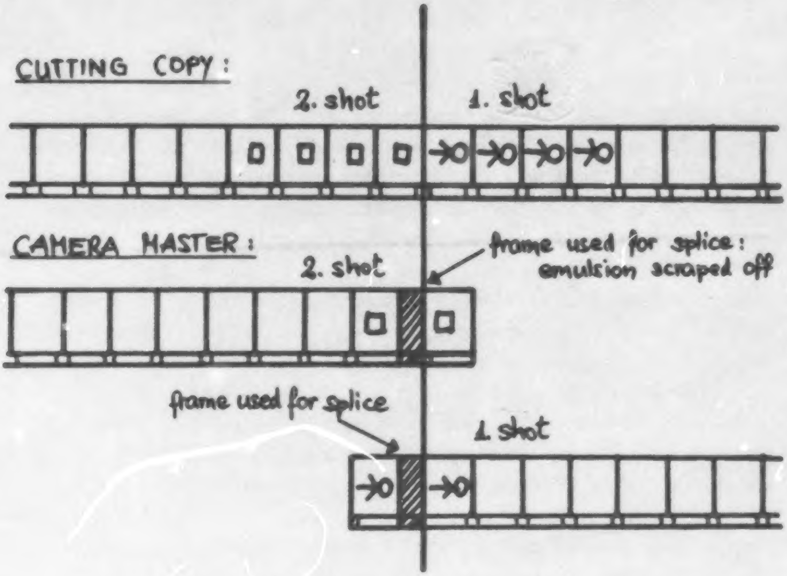
Tape Splicing

A tape splicer is the most convenient instrument for picture splicing and it is essential for splicing the sound film. The tape splicer is equipped with two knives, one to make straight cuts, i.e. cuts perpendicular to its length. The cuts are made along the line which separates two frames. Both segments which should be joined end to end are placed beside each other in the tape splicer, so that they do not overlap. The tape which is used to join them is a transparent polyester tape coated on one side with adhesive material. The adhesive side of the tape is pressed onto the emulsion side of the film. A somewhat better splice is achieved by taping both sides of the film. Cutting copies are always done with the tape splicing method. This is quicker and needs less skill, than cement splicing, but it also avoids any loss of frames. It also allows re-making the splices without any frame loss. The magnetic film, i.e. the sound is always cut with the tape splicing method, but the cut itself is diagonal. This aids the smooth flow of film over the sound heads and keeps distortions to a minimum. It also avoids a "click" sound as the splice passes over the head. A method to ensure accurate joining of magnetic film is to make a vertical line on the frame line as a mark on both ends. If the join is made correctly the marks on both pieces of film will reconstitute a whole line.

Cement Splicing

A cement splice is usually made by joining the emulsion side of one piece of film to the base side of the other piece. Different cement splicers are slightly different in operation, but in principle the emulsion of one piece is scraped off and removed. Then the cement is applied usually to the scraped surface and both pieces of film are pressed one onto the other for a short time. Cement splicing needs experience. The emulsion of one of the ends to be spliced together should be removed, so that the base appears, but not too much of the base should be scraped away or the splice will be weak.

Also the amount of cement is critical. If it is too much, the splice will be messy, if it is too little, the splice will not hold. Since the operation is not easy and because at least two frames are lost (one on either side) cement splicing is normally only applied for cutting the master.


CUTTING COPY:
2. shot
1. shot
CAMERA MASTER:
2. shot
frame used for splice: emulsion scraped off
frame used for splice
1. shot

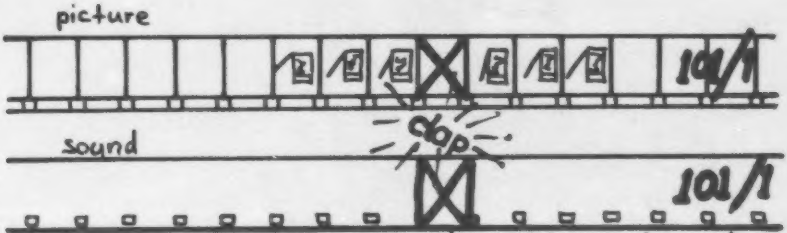
SYNCHRONIZATION OF RUSHES

Where sync. sound has been shot, it is clearly essential to have the sound available for projection with the cutting-copy when the rushes are viewed. The sound recorded on $\frac{1}{4}$'' tape during shooting will have been transferred to 16 mm magnetic film, when they return from the lab, the picture and the sound will not be in continuous correct synchronization, since the recorder and camera will have been frequently stopped and restarted for the different takes during shooting.

BEST COPY AVAILABLE

Furthermore because the recorder is always started before the camera, there will always be more sound than picture. The editors first job to get both rushes in sync. is to cut out the extraneous sound film. The procedure for this is as follows:

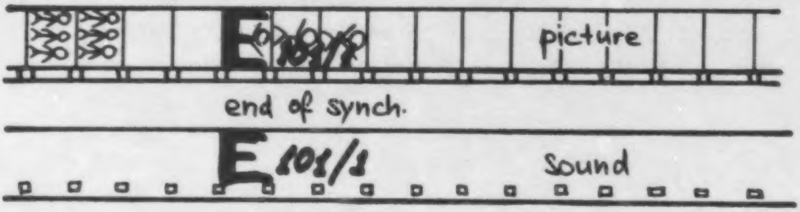
Two white leaders are laced in the synchronizer and attached to two take-up spools on the rewind arms. The leaders are marked with: Prod. No. Title 'action' rushes. Reel 1; Head and Prod. No. Title Sync. Dialogue. Rushes. Reel 1; Head. After several feet of white leader, black spacing is attached and near the beginning of this a sync mark is made on each roll. The marks need to be on exactly the same frame on each roll. Different marks are used for picture and sound sync. and both are preceded and followed by a continuous line for one or two feet, to assist location of the sync. mark when winding through quickly. Since the 16 mm and 35 mm picture and sound run with the same speed (24/25 f.p.s.) through the synchronizer and they both have the same perforation holes, the sprocket holes can be used for orientation. After about 6 ft. of black leader, the first picture take is attached to the action roll, including the slate. The film then should be run through the viewer until the frame, where the arm of the clapper board first makes contact with the top of the board. This frame should be marked with a chinagraph pencil. Next, the sound film should be thread



Marking with the clapper board on picture and sound into the third way of the synchronizer and run over the sound head until the announcement of the first slate is heard, followed by the sound of the clapper. The first frame of this sound should be marked, and placed in sync. with the picture strike frame.

All rolls then should be wound back to where the picture is joined to its leader. At this point, the leader of the sound roll should be marked, the sound removed from the third channel and cut at its mark. Then the sound film is joined to its leader. The slate announcement should be kept on the sound roll at this stage. Now that the sound is attached to its leader, both picture and sound should be wound through together to check that the strike frame on picture and sound coincide. If they do, both rolls should together be wound further till the end of the shot. Here the procedure should be repeated and the end marked parallel on picture and sound.

Marking the end of a shot:



With some cameras, the engaging of the camera motor results in approximately six flashed picture frames through a small lamp, which exposes the film. The last flash frame coincides with the pilotone signal. The pilotone frequency is recorded on the fringe of the tape. The synchronizer stops automatically with the start of the pilotone if the respective button is pressed. Here, the sound film is marked at the start of the pilot as is the last of the flashed frames. If both marks are laid parallel, picture and sound will be synchronized.

If there is no sync. mark at all (clapper board or others), eyewatch is necessary. In a close-up it is comparatively easy to see what is said, but even in a long shot this is possible with a certain amount of practice. The sound is easiest to see when labials are produced, i.e. the letters b, m and p, because the lips here are tightly closed.

The same procedure has to be done, when the next shot is cut to the workprint, since camera and tape recorder do not start at exactly the same time. If the sound has to be pulled forward the sound is either too long or the picture too short. The sound could be either shortened or the picture extended. If the sound is pulled back, the situation is the reverse. When picture and sound are synchronized at this stage it is useful to substitute missing pictures or sound with spacing since it is not yet decided where to put the final cuts.

The sound trims, those portions of sound film removed during the synchronization process should be carefully rolled, marked with their slate and take number and stored in clearly labelled cans. Some of these sound trims may be long and it is likely that much of it sill be never used, but none of it should be thrown away before a mixed master of the sound track has been made. They should be clearly marked, because magnetic film cannot be identified by holding it simply to the light.

At the end of each roll of film and of sound film, a length of black spacing should be attached, followed by a couple of feet of white leader, bearing the same information as the head leader with the obvious exception that the word "head" will be replaced by the word "tail".

LOGGING

With the rushes synchronized the preliminary work, preliminary to the real cutting work, is not yet ended. The next step for the editor is paper work. The main function of the paper work is to list the material to make cutting itself easier. First he should log all the details of the available material. If specially prepared sheets are not availalbe for listing his stock, a book should be prepared with various columns, to record at least the following details of every shot:

SLATE NO.	SCRIPT NO.	ACTION	DIALOGUE	EDGE NO.	REMARKS
84 Take 1	37	CU Alun, slow pull back as lines spoken, to include R. who beat drum	Such loving... ....rarely loved.	947213 -242	Cam. movement doest't tie too well with lines Slightly underex., too.
84 Take 2	37	do	R. Books at 'they loved...	242 -249	NG
84 Take 3	37	do	As Take 1	249 -276	OK but final framing rather weak and slight jerk in zoom
84 Take 4	37	do	do	276 -301	Zoom matches lines much better; framing OK
84 Take 5	37	do	do	301 -330	Movement and framing OK - J. moves rather awkardly: perhaps not as good as t. 4

The logging sheet will help in keeping a record of what is in the film and what is not, they will help in making decisions about the general editing pattern of the film, they will help locating shots for use and in selecting additional shots, cut aways, etc. without the need to wind the film back and forth. They will also help to locate shots in the master when the time comes for master assembly.

The second important piece of paperwork is the transcription of all unscripted dialogue. It is advisable to write out the exact words of interviews. In addition remarks should be made about the quality of the recording, the suitability of the subject matter and the like.

It is also important to record if the sound source is visible in the picture or not. S = Synch. would denote that the sound source is visible, W = Wild will indicate that the sound source can not be seen in the picture.

The thorough transcription of all spoken material is very important. It is easy to imagine, that it is far quicker to find, judge and select and interview on paper, than to search through miles of film or tape.

SELECTION OF TAKES

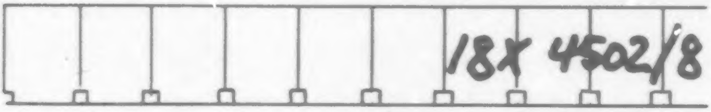
When the cutting-copy is synchronized to the sound and logged, the editor and director will look at the entire rushes in order to decide which shots should be included in the final film and which not. The editor, if he has not been present during shooting, now has become familiar with the film. Through viewing and breaking down the film he has already made decisions and has developed a fairly good idea about the editing patterns of the material. The editor and the director need to consider all aspects of the shots: the pattern of movement, the quality of the sound recording, and its freeness of extraneous noise, the framing of the shots and the camera movement, and the technical picture quality when they decide which shots to choose. Also possible cutting points are now clear. If, after careful thought, the right choice is not apparent, both takes should be included in the first assembly, and the final choice deferred until more detailed work has been done in the construction of the film.

BREAKDOWN

The real work starts then with the breakdown of the cutting-copy.

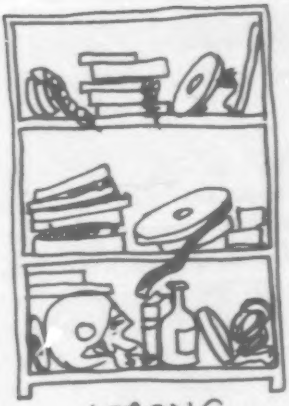
All choosen takes are separated from the rest, numerated and hung up on a clip rack, pin rack or whatever film filing system is used. The numeration is important especially for cutting the master. Normally the film comes out of the lab with latent image edge numbers which are visible with transmittent light and appear at intervals of 20 or 40 frames. The numbers progress in sequence.

If out of many very short cuts a sequence has to be assembled, it can happen that none of the used places bears the edge number. Therefore with very short takes or cuts, the number has to be written on the film.

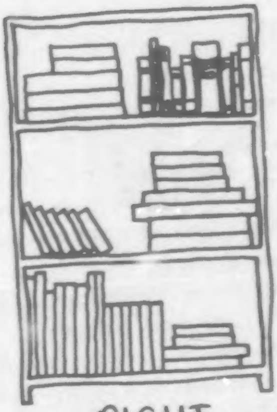


So, for example, the edge numeration 18 x 4502/3 would mean that the eights frame after the edge number 18 x 4502 is the start of the take. As far as possible, shots should be hung on the bins in script order with the sync. tracks, the sound always hung with its related picture and clearly marked on both sound and picture film with the sync. mark. In many films there will be too much material to be hung up at once. In this case the film can be broken down and then assembled in convenient sections. At this stage of the film it might also be better to work with several small rolls than one or two large ones. The unwanted takes should be rolled up, picture and sound together and stored in clearly labelled cans.

It is useful to mark all cans containing unwanted takes with tape of the same colour. The chosen takes are numerated either by hand or by machine, i.e. picture and sound are numbered starting with the clapper board in regular intervals. This is not only important in short takes of a shot, where the latent image edge number can be lost while cutting, but also when



WRONG



RIGHT

one has to cut from one shot to the next and back again. Without numeration, synchronization would get lost in this respect.

ASSEMBLY

The takes selected are joined in script order end to end on as many reels as are necessary. If sync. sound is being assembled, the two rolls, picture and sound, are assembled together. Care has to be taken, that all sync. marks are kept aligned and coincide. Since the first assembly simply sorts the shots into the right order, the individual shots are not cut in themselves and also the slate number and the announcement will be left in at this stage.

THE ROUGH CUT

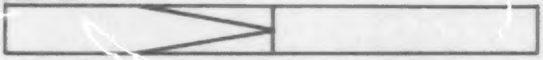
Montage in the real sense is divided into rough cut and fine cut. The progression from the rough to the fine cut of the cutting-copy is continuous, so rough and fine cut are relative rather than absolute terms.

The first job in the rough cut will be to cut out slates and take announcements, but leaving plenty of sync. marks on the remaining film. The sync. marks are now, when the clapper board is cut out, even more important than before, because they are the only means of orientation. One now begins to make decisions about re-positioning shots, and possibly sequences, about the length of the shots and about how to cover up for shots that have not come out the way they should have. Also the final selection of alternative takes is now made as well as the selection of cutting points, the use of opticals and special effects. While working on the cutting points, the use of opticals and special effects. While working on the cutting of the film, the editor uses a number of standard markings, made on the film with chinagraph pencil to indicate the ideas that can not be put into effect until the final cut of the film.

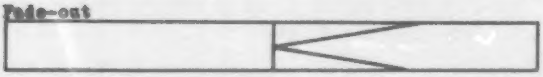
Where other special effects and opticals are to be used, they can be indicated by splicing in a section of marked black leader until the optical has been produced and a cutting copy of it is available. The outs of the rough cut are put into clearly labelled cans. It is useful to use another colour to mark the cans with tape than was done before, because it is often necessary to use part of the outs for the fine cut.

The following signs are used:

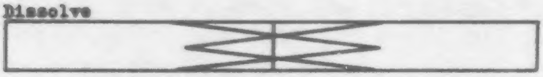
Fade-in



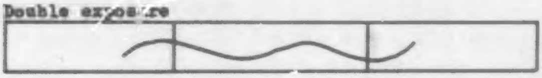
Fade-out



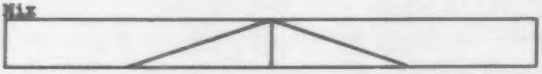
Dissolve



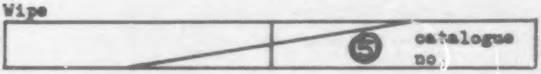
Double exposure



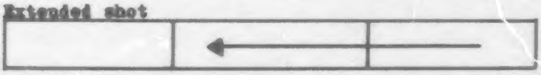
Mix



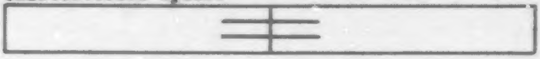
Wipe


⑤
catalogue no.

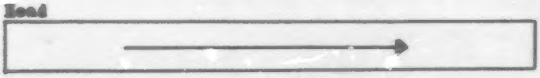
Extended shot



Unintentional splice



Head



THE FINE CUT

In the fine cut, the editor has to make the final decisions. This does concern the exact length of each shot. If the rough cut has cut two shots together to the nearest half dozen frames the fine cut must decide to the exact frame. In the fine cut stage the editor must find the ideal place for every cut in the film, and normally there always is one. Furthermore decisions of the rhythm and the structure of the film are made, according to the concept of the film. There are several editing machines available, the three most widely used for 16 mm work are the Moviola, the Acmade and the Premier. The picture is displayed on a small screen, while the sound, on a seperate magnetic film is run through a separate threading path. The drive for both picture and sound are locked together in sync. and driven by an electric motor. Controlls allow forward and backward movement running at normal and double speed and allow the picture to be stopped instantly on any frame. An inching knob allows limited movement for frame-by-frame inspection.

In addition to editing machines, flat-bed editing tables such as the Acmade, the Steenbeck and the Prevost exist. On a horizontal, table-top layout, they run picture and sound separately, in sync. and have an instant stop, inching, reverse running, double speed etc. The real advantage of most editing tables is that they are able to run two or more sound tracks simultaneously so that, when the tracks are being laid, it is possible to judge the effect of two or three tracks at the same time.

On what is perhaps the most sophisticated of all these tables, the Prevost 8-plate, there is even provision for mixing sound from two tracks on to a third, so that trial mixes may be made before compiling the dubbing chart. (For the complex of sound editing see the separate paragraph on the problem.)

Since the cutting of the camera master is a difficult task, several points should be kept in mind while cutting the fine cut, no matter if the editor does it himself or gives it to a lab.

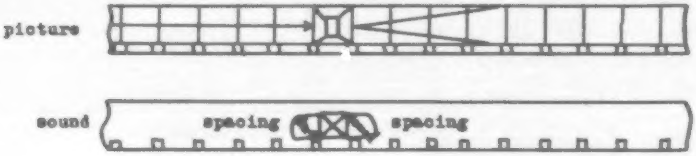
The cutting of the cutting-copy is normally done with the tape splicing method. The master is cut with cement splicing. Since cement splicing needs scraping and overlapping two frames on each side of the end to join get lost. To take this into consideration while preparing the final cut of the workprint is important.

Since it needs some time (frames) for the camera motor to reach its normal running speed, the first three to four frames are overexposed. Therefore while preparing the final cut, the editor should cut off one or two frames after the beginning of a shot, i.e. should wait till the frames are usable.

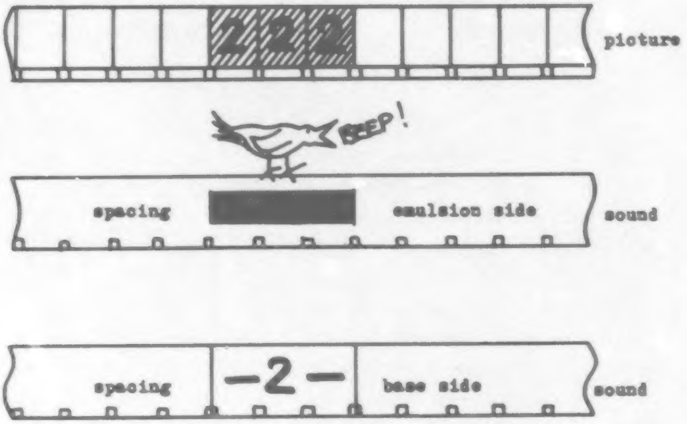
If one shot should be incorporated twice in the final film, the editor should again think of the master assembly. If for example part A of a shot is used in the beginning of a sequence and part C is to be shown at the end, two frames (part B) have to be cut in between to make workprint and master, equal in length and synchronized.

It can happen that, while assembling the workprint, a shot is chopped. If this is a shot which is needed in the final film and repair is too difficult, the chopped part should be replaced with white or black leader. To make clear what part should be used in the final print, the leader should be marked or numerated.

To assemble the final cut, academy leader should start the roll. For the sound film, spacing of the same length should be used. Picture and sound should be placed parallel on the editing table and the startmarker should be applied to the respective frame of the sound film.



The next mark to be transferred is the 2 on the academy leader. At the same place tape with the recording of a 1000 Hertz sound should be applied to the sound film for three frames. This mark is the sync. mark, when the sound is mixed.


2 2 2
picture
BEEP!
spacing
emulsion side
sound
spacing
-2-
base side
sound

Now the leader is run for a while till the first frame is joined. The marking of the start is also applied on the sound film.

After the synch. marks are applied to each shot and the signs for effects and opticals are marked for each take, the fine cut is ready.

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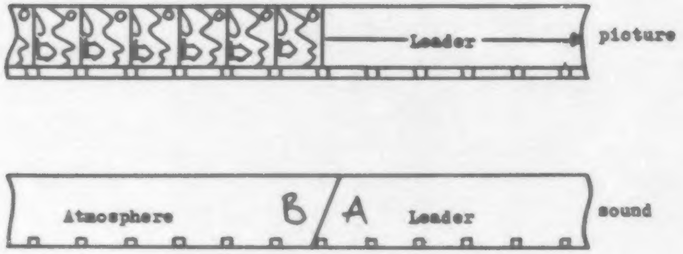


MASTER ASSEMBLY

The master assembly again begins with logging the edge numbers of the shots finally used for the film and sorting out the relevant takes from the master. Before the cans of the master are opened, the cutting bench should be clean, the trim bins or clip racks to be used should be empty and the bags are clean. Also anyone who is to handle the film should be provided with a pair of soft clean cotton gloves. Master film picks up dust and fingerprints with alarming ease and it should always be remembered, that this is the film from which the final copies are made.

All the required takes should be cut out of the master, identified by the edge number and hung up in the script order.Pre-numbering of the clips will speed up the procedure. The spare master, i.e. the left over, after the required takes have been taken out, should be rolled up and stored out of way. When cutting out the required takes, plenty of space should be left on each side of the shot or preferably the whole shot, including slate and clapper board should be cut out.

Mistakes in master assembly always mean a slight alteration in the cutting points, no matter if the frames were lost through careless cutting, poorly adjusted splicers or just by plain boobs.

A 16 mm master can be assembled all in one roll and printed straight off. The shots are simply joined head to tail and the use of a synchronizer will make location of the exact cutting point easier. The only point here is to remember, that with scraping and splicing frames get lost through assembling with cement splice, as is shown in p. 376.

But printing from a master assembled in one roll has several disadvantages. First of all, all splice marks will print through onto the final film. That means, that except those which happen to be in dark areas of the frame, the splice marks will be noticeable on projection. Furthermore, all opticals except fades have to be produced separately when the master is assembled in one roll. For the effects the master for the opticals has to be sent to a lab, where the effect will be produced on an optical printer. The completed effect will be later included in the master for printing.

SOUND EDITING

It might be misleading to discuss soundtrack work after picture work, because both are invariably cut together. All aspects of sound editing must be considered as an integral part of film editing and must be thought about at the same time. The degree of interaction of picture and sound varies with the type of the film. A 'Top of the Pops' record-illustration film is certainly different from a news reel in respect to the interrelation of sound and picture. Whatever the degree of interaction, the sound track is a major creative contribution to the film and should not be regarded merely as background to the pictures.

Moreover, the sound track is not nearly so evident to the audience as is the picture.

Special camera effects and handsome camerawork will impress any audience, as will many forms of skillful picture cutting. Good sound recording and editing, even special effects sound work, will, on the other hand, be invariably taken for granted. Therefore, not only recording of sound but also the editing of it has to be taken as seriously as picture editing.

In all but large scale pictures, the sound editor will probably be the same person who does the picture editing.

TRACK-LAYING PROCEDURE

Although some films will start picture cutting with the sound-track finally established - films involving precision cutting to music beats, for instance, or animated films, especially those with dialogue which requires a complete sound-track before shooting can even begin - track-laying will take place more or less concurrently with picture cutting. Most track-laying will be done in the late rough-cut and fine-cut stages, to enable modifications in the picture cutting to be made easily, while at the same time having a fairly good guide to the probable final shape of the picture.

The sync track (or tracks) will, of course, have been cut with the picture in all its stages, and is almost a self-laid track. The decision to be made at this stage about the sync track are reduced virtually to questions of what level (sound-volume) to use, where to use the track, and where to omit it, and whether it can stand on its own, or needs reinforcement. All other tracks, however, must be recorded and laid by the sound editor, from scratch.

Tracks are called all the different types of sound which should be included in the final picture, but which are recorded on different tapes. The more differentiated the distinct sounds are handled, the better will be the quality of the final mixture. This means that it is better to separate sounds as much as possible. It is even advisable to transfer the sync.-sound of several takes of one shot on different tapes, since the quality of the recording can be different in the takes. If they are transferred on two tapes, it is easier for the sound-man to correct on different channels and to use only the best parts of the takes.

The tracks laid are usually classified by the kind of sound they contain. So there are:

sync tracks - those shot with the picture
post-recorded dialogue etc.
commentary and voiceover tracks
effects (FX) tracks
tracks with atmosphere and background sounds
music tracks
loops - referring to the nature of the track rather than the sound it contains.

The first task is to collect and record all the sound necessary. Some sound may have been recorded on the location while shooting: sound effects difficult to obtain elsewhere, interviews for voiceover tracks and perhaps some over-all guide-tapes to remind the editor of the total effect that he is trying to re-create. The editor will run through the rough cut of the picture, with the sync track if there is one, and note down where he has appropriate material to compile the track, and where more sound needs to be shot.

At this stage he will be making broad policy decisions about the sound-track and he will naturally be guided by the film's script. The script will not though, contain details such as particular FX, for example, unless they make a specific point. The editor must fill all the gaps left in the script by careful examination of the cutting-copy.

The editor will now arrange for all outstanding sound to be recorded, including commentary.

When all sound is collected together - probably mostly on $\frac{1}{4}$ in. magnetic tape - it is sent to the labs for transfer to 16 mm magnetic film. If a certain amount of tape editing can be done before, worthwhile savings can be made on transfer costs; in addition, large-scale editing of sound is usually easier on $\frac{1}{4}$ in. tape than it is on magnetic film. Large sections of unusable interview, for example, are easily excised, as are mistakes made during a commentary which have subsequently been re-recorded. Transcription of all interview and other voiceover material will make initial editing far easier: the time taken in writing all available speech down on paper will easily be made up in time saved during editing. It is much easier to turn over a page than to rewind 500 ft. of tape, or change a spool of tape, to see if a phrase is repetitious, or to compare content.

The tapes for transfer should be sent to the labs with all details of the recordings, and of the transfer required. Check that edge-track (E/T) or centre-track (C/T) is chosen according to the editing equipment to be used, and also that it is consistent for all sound throughout the film.

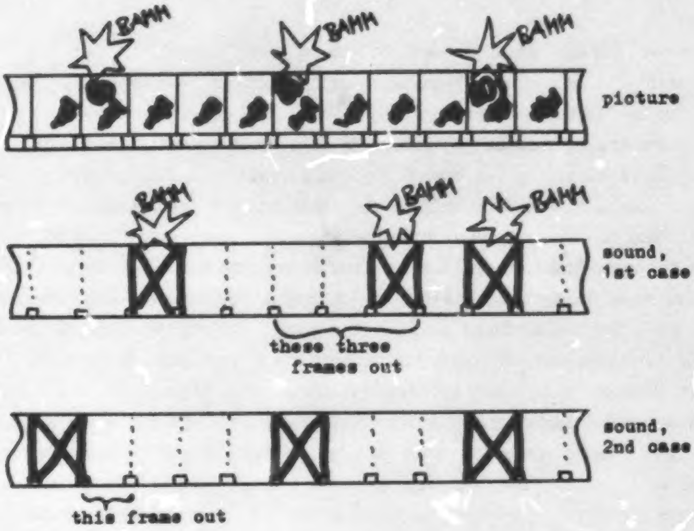
Once the sound is all transferred to 16 mm film, the building up of the tracks on the film can begin in a synchronizer. Each sound-track should have a white leader containing all information, followed by 6 ft. of black leader with a sync mark level with that on the cutting-copy.

Care must be taken that all tracks and all stages of picture are kept in correct synchronization - lost sync can be troublesome to trace and rectify.

Sometimes it is useful not to cut picture and sound point to point in the strict sense, i.e. picture frame and sound frame in sync. but let either sound or picture precede the cut. In this way cutting points which have mechanically not come out to their best, can be smoothened and the flow of the film can be improved. So, for example, one shot of a man looking out of a window followed by a shot of the fire brigade arriving can be improved in certain cases, if the horn of the fire brigade's car is heard while the man is still shown standing at the window i.e. before the car is seen in the picture. The same applies when using atmospheric sound. To make a good recording of speech, a special microphone is used, which is most suited for the purpose. If the recording of the speech would be used alone in the film, the sound would seem unreal, because the audience will sub-consciously expect the appropriate noise of the particular location, which is missing in the speech recording. Therefore on a separate track atmospheric sounds and the typical noise of a place is recorded, to be mixed in. To allow for an easier transition from tape to tape and to get a smooth junction, it is useful to let the atmospheric sound project at the end of a shot for approximately one second. So no drop-out will appear in the mix.

It is clearly more complicated to get non-sync sound effects into sync. For example a sequence which contains several shots showing a man breaking stones. In a long shot, showing many men it is comparatively easy to fit the sound, because a wild banging will be appropriate. If a medium shot or a close-up of only one of the men has to cut in, fitting the sound can be difficult. Now it is necessary to get each bang in sync. with the picture. When the first sound is laid to the picture in sync. and the second beat comes too late on the sound-track compared to the picture, the sound-track has to be cut. But it can happen, that the second bang comes too early on the sound-track. In this case the third beat of the sound-track is used, and the second beat is cut out to extent the interval between the beats.

It is necessary to fit the "visible" sounds to the picture, otherwise the viewer will be irritated.


BAMM
BAMM
BAMM
picture
BAMM
BAMM
BAMM
sound, 1st case
these three frames out
sound, 2nd case
this frame out

If all the sync's are assembled the sound takes on magnetic film can now be separated and hung up on clip racks like action takes - although some takes may well be too long to hang up conveniently like this. Music and commentary, for example, may continue unbroken through many cuts in the picture, and these takes on magnetic film can be rolled up, on or off their cores, and stored in clearly labelled cans. All sound takes must have their content and direction of travel marked on them as soon as the sound rushes are cut up.Failure to label sound takes can cause much time to be wasted in running bits of magnetic film over playback heads for identification.

Tracks can be built-up one at a time, or up to as many as three at a time on a four-way synchronizer.

In the early stages it is as well to make a rough assembly of each track separately to the picture. Then, when all the tracks have been put together, they can be checked against each other, and minor adjustments made to the tracks and the picture as necessary. At this stage of the proceedings, work is made much easier by the use of a picture synchronizer (pic-sync), which incorporates a viewing screen into the first channel; this enables the sound and picture to be run through together locked in level sync, so that the sound for each frame is directly in line with it on the synchronizer. In more advanced stages of track-laying, of course, editing-machines are essential, both for the picture, as described above, and for running the sound to the correct speed, to judge its effect. Music particularly, is very difficult to hear clearly on hand-wound synchronizers, especially if it contains no marked beats. The more sophisticated editing-tables are also invaluable in later stages of track-laying, in order to run two or three tracks together with the picture, and thus to judge how the various tracks will interact with each other, and how the total effect will fit to the picture. If the editing-table has mixing facilities, the editor can make a series of trial mixes: the best one can then be sent to the dubbing studio to guide the dubbing mixer when the final mix is made.

Whatever equipment is used, the laying of the tracks continues until the full sound-track is composed. It is usual to block in spaces between sound takes with discarded exposed film stock, although specially coated leader is preferable. However, care should be taken to ensure that there is at least one track incorporating magnetic film - modulated or unmodulated - at all points of the film. If there is a continuous sync track, there will be no problem, but if, for example FX only are to be used in a film, care must be taken that all spaces are filled by magnetic film, on at least one track, otherwise, if any gaps appear, the 'drop-out' of the background noise will be noticeable. 'Fill' or 'shush' can be used to level out drop-outs.

Each roll of sound-track should be completed with tail leaders and tail sync marks, as for the ends of all rolls of material. When they are completed, they should be rewound firmly and evenly, put in cans, and the cans clearly labelled. Splices should be re-checked during re-winding: splices on magnetic film, it should be remembered, are always made with the tape splicer on the cell side only, and using the diagonal cut.

In addition to these laid tracks, matched on the synchronizer with the picture, there may well be other sound material to be arranged for the final dubbing sessions. In addition to the material already mentioned, disks may be used in the mix: most labs will offer at least one disk play-off, and this may be the most convenient source from which to swing in some sections of general background effect or music. Then ¼'' tape play-offs may also be incorporated in the same way. If some general sound can be mixed direct from tape some transfer cost and track-laying time may be saved. Probably the most widely used form of non-laid track is the loop, a section of magnetic film joined at the end in a continuous loop which can be threaded up into a replay channel in the mixing equipment, and brought in and out as required. A loop is used mainly for atmosphere tracks and for general effects, but the system has only limited uses. The sound intended for loops must obviously not contain any marked features which will become noticeable on repetition. Common examples of loops are background traffic noise, external country atmosphere, general noise in a rum shop etc. When making the join in the loop, a cutting point should be chosen, where the flow of the sound seems uninterrupted. A change of level, or a sound cut halfway which re-appears every ten seconds for example, becomes as noticeable as any marked feature on the recording. Before joining the loop, the maximum length acceptable to the dubbing studio should be checked.

On the loop itself its content and the direction of travel should be marked, and the loop should be sent in a marked can.

DUBBING CHART

When all the tracks are complete, and all final adjustments have been made to picture and sound, the dubbing chart (or cue sheet) must be compiled, to inform the dubbing mixer of the contents of the sound-tracks, and the editor's intentions as to their mixing. Again, accuracy is imperative in the compilation of the dubbing chart. The dubbing mixer at the sound studio will be completely fresh to the film, and the dubbing chart is the communication link through which the editor tells the mixer about the film. If possible, the editor should arrange to be present at the dubbing session of his film: if he cannot attend, full detailed instructions about anything unusual should be written in addition to the dubbing chart.

Some labs will issue their own blanks for dubbing charts; where this is the case, these should always be used, as their mixers will be used to working from them. Where no particular pattern is issued, a general-purpose cue sheet can be obtained from editor's suppliers, or a piece of blank paper ruled into columns will do. For small-gauge film-making, vertical columns are normally used: some features companies use horizontal charts for some tracks. One column is used to represent each track, and each column is headed by its description and number. Sections of the column are blocked in to represent sections of sound in that track; footage numbers at the beginning and end of the section are written in, and blocks are sometimes coloured, for easier recognition. The nature of the sound is written in the block; in the left-hand column, the action cues - footages and brief descriptions of the pictures - are noted.

Fade-outs and fade-ins on the sound are indicated by pointed (instead of straight) ends to the block; where a fade-in on one track coincides with a fade-out on another, a sound mix is shown. Where one track fading under another is desired, the block is narrowed from either side in the track to fade down; the superimposed track remains at full column width.

Loops, disks and tapes each have a column to themselves; there may well be more than one of each used, and in this case a fresh column should be drawn up. Many loops and disks may be available from the library at the dubbing studio, especially widely used effects and atmospheres. It is worth checking with the studio to see if they can supply the sound required; as a general rule, however, it is safer to hear the sound before it is incorporated into a sound-track. and if the editor cannot be present for the dubbing session, it will be wiser if he prepares all his own sound where possible.

A dubbing chart may well become very involved, with many tracks, but, for example, a simple track may look like this.

Colouring the blocks with a different colour for each track may assist legibility; in any case pay maximum attention to neatness and clarity, as the dubbing mixer will have to read the chart while at the time looking at the picture projected on a screen, and at a footage counter, with his hands working the volume control slides. Any difficulty with reading the dubbing chart can only make his job more difficult, and a satisfactory result less likely.

When the dubbing chart is completed, it is packed off with the various tracks to the dubbing studio for the final mix. Once the mixed magnetic master has returned from the studio, it should be carefully checked against the cutting copy of the picture, and the general quality of the sound checked. If it is satisfactory, it can now be sent with the picture master to the labs for the final printing on to the married print, either as an optical track printed on photographically, or by a further magnetic transfer to a magnetic stripe applied by the labs.

A good exercise in understanding sound editing is to put a reel of a feature film on a Moviola, and analyse the sound-track by attempting to reconstruct the dubbing chart.